

THE
Journal of the
AUSTRALIAN INSTITUTE
OF
AGRICULTURAL SCIENCE

PUBLISHED QUARTERLY



SUBSCRIPTIONS : Within Australia 10/6, British countries 11/6, Foreign countries 12/6 per volume of four numbers, and 3/6, 3/3 and 3/6 respectively per copy, post paid.

Issued Free to Members of the Australian Institute of Agricultural Science.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

VOL. 9, No. 4. DECEMBER, 1943.

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VOL. 9, No. 4

DECEMBER, 1943

Agricultural Education in Victoria

REPORT OF THE VICTORIAN BRANCH.

This report on post-war agricultural education represents the views of the Victorian Branch of the Australian Institute of Agricultural Science. Members of the Branch who are officers of the Department of Agriculture assisted in the preparation of the Departmental report and were not associated with the drafting of this document, which was prepared by committees of the remaining 66 members of the Branch and presented to the Rural Reconstruction Commission by the President of the Branch, Mr. J. A. Aird, in September, 1943.

Agricultural education is considered in two main divisions, namely, education in the farming community, and university and post-graduate training.

EDUCATION IN THE FARMING COMMUNITY.

Primary Education.

A subject known as agricultural science has been included in the curriculum for country primary schools for some years. The syllabus is ambitious and is rarely achieved, mainly on account of lack of sufficient time and suitably trained teachers. In our view the teaching of such a subject is a waste of time and should not be attempted in primary schools. We recommend that at this stage preliminary agricultural work should be limited to (a) the teaching of "farm" arithmetic, (b) the use of economic plants in the elementary general science course, (c) the development of the agricultural side of economic geography, (d) the encouragement of initiative and self reliance by means of handicraft subjects and Young Farmers' Clubs.

We look forward eagerly to the development of the Area School system in Victoria, but too much should not be expected of it in the teaching of agriculture. If it makes available to all country school children a well-taught, primary curriculum, it will be doing good service. Above all we hope it will leave the children with the ability to observe keenly and to read the printed work intelligently.

It is realized that the results achieved will depend entirely on a well trained and adequately paid teaching service and provision of equipment necessary to satisfy modern standards.

General Secondary Education.

In secondary education the good work can best be continued by a broad general science course. For this the training of teachers on the biological side should be

strengthened, and consideration should be given to the University course in Agricultural Science for this purpose. As the various principles are discussed in the general science course in the high schools, the applications to agriculture may be indicated, but very little more.

The importance of a sound English course in developing the habit of intelligent reading is emphasized. Further handicraft training is also very desirable.

Agricultural Colleges.

Agricultural colleges should be regarded first and foremost as educational institutions and they should be administered, staffed and managed as such. Activities should be designed and arranged to educate the students, revenue being a secondary consideration. While agricultural qualifications are desirable for the teaching staff, the ability to teach is of first importance.

Entrance Standards. The courses should be designed primarily as an education for farming of the sons of families already engaged in the industry, and entrance arrangements and standards should be designed to facilitate the entrance of such students. To that end it is recommended that students be accepted at age 13 with Merit Certificate qualification direct from primary schools.

The *College Course* for students entering at this age should be one of four years, in the first two years of which their cultural education should be continued as a preparation for a course of similar type to that now given. It is considered that this change would permit a broadening of the course and enable a better training for life and for citizenship to be given.

The value of practical work is not under-estimated, but in our view it is more important that a college graduate should know why things are done than be expert in doing everything.

Post-Graduate Work. The College diploma or certificate should be awarded for the successful completion of the basic four-year course mentioned above. In addition to this course it is recommended that facilities be provided for short specialized post-graduate courses, for which the following are suggestions: dairy supervision, butter and cheese making, orchard work, farm mechanics, wool classing, field experimental technique. This recommendation envisages special training for that portion of the students desiring to seek employment in various capacities.

Employment of Graduates. More use should be made of College graduates as technical officers in research and investigational work. It is further recommended that a College diploma be a basic requirement for appointment to the inspectorial services of the Department of Agriculture.

Special Farmers' Schools of Instruction. Agricultural colleges are the logical places for short refresher courses and schools of instruction for farmers, but special accommodation facilities and staff should be arranged for this purpose. Such courses can be too important a function to be relegated to college vacations and a scratch staff.

Administration. The chief disadvantages of the present system of administration by the Council of Agricultural Education are absence of educationists on the Council and the fact that its staff are outside the State Public Service and not attached to any department in whose service they may hope for promotion. Careful consideration has been given to a better arrangement and it is recommended that the colleges be placed within the Department of Agriculture as part of the Extension Division. In the administration of the colleges the Department should have the assistance of an Advisory Board constituted, it is suggested, as follows: the Director of Agriculture (Chairman), the Superintendent of Extension Work (Executive Officer), the Director of Education or his nominee, a representative of the University, and three representatives nominated by the Chamber of Agriculture.

It is considered that university graduates in agricultural science, from which the Department at present recruits its personnel, could adequately staff the colleges if given one-year post-graduate training in teaching. After serving for a period at the colleges they could later move to more appropriate positions in the Department of Agriculture than they could in the Department of Education.

Adult Education.

It has been estimated that there is a lag of from 10 to 15 years between the discovery of new agricultural methods and their application by the farmer. Agricultural extension is education to reduce this lag to a minimum.

Extension work in Victoria is at present conducted by the Department of Agriculture, various other government authorities and commercial organizations. These bodies work through associations of primary producers and also by direct approach to the individual producer.

The present methods and organization of the Department of Agriculture are discussed only as incidental to the various sections of this report, as it is believed that the details will be given in evidence by the Department. Some comment is made on the work of other authorities and on the organization of the primary producers.

Victorian extension services to primary production are considered to be generally inadequate, even in those industries which are best served. Present methods vary in each industry and include numerous unsatisfactory features and deficiencies. Such services as are given suffer from lack of that drive and direction which can best come from a central organization appointed with the specific purpose, while the need for specially trained men for rural districts is equally apparent.

It is considered therefore that the establishment of an extension service as a separate division of the Department of Agriculture, together with a division of publicity and an intensive training for resident District Officers, is essential for future development. This is the essence of the following detailed comments and proposals.

State Extension Service.

The State extension service should be a separate division of the Department of Agriculture. Resident District Officers should be appointed, and whatever their major speciality they should be members of this service. In some districts, the District Officer will need assistance in one or more branches, perhaps even in his speciality. Thus, to some extent, his work will be administrative. In any horticultural district he would need such assistance, unless horticulture was his special subject. In the Goulburn Valley, which provides a special example, horticultural extension might be considered the major work and in this event an officer with special training in horticulture would be selected as District Officer. In addition, he might have an assistant horticultural extension officer who would also operate in adjoining districts such as the North-east.

Provision should be made for direct contact between district officers and specialists. A special abstract service should be provided and a library made freely available to all officers and their staffs.

The present organization of district war agricultural committees offers a framework on which the extension service might be built.

Training of Extension Workers.

Extension work requires special training, as much as any other form of professional activity.

The University Degree in Agriculture is to be preferred as a basic requirement, and following graduation there should be at least five years' practical experience in the special section of agricultural activity selected, as for example, agronomy, horticulture, dairying. This practical experience may be obtained in the employment of the department, on one of the research farms.

and in connection with investigational work. Alternatively, it may be obtained in field work with the Council for Scientific and Industrial Research, in commercial employment, in university research or in other approved ways. It should also include experience in assisting in the management of the farm. It is important that extension workers be qualified to discuss the implications of the technical advice they give in relation to problems of farm management and finance. During this period, also, experience should be sought in organizing and arranging projects and activities in the local rural community, such as progress associations, agricultural societies, sporting clubs, and the like.

Later, the trainee might be placed with advantage as an assistant to a District Officer with the specific responsibility of making a survey of two or three different aspects of agricultural activities or live-stock farming. Apart from the probable value of such surveys, which would provide much information about types of farming, farm practices, organization and production, which are now unknown except in the personal knowledge of a few people, the work of carrying them out would train the man in many ways that would subsequently be useful to him. It would train him to see a farm as a whole and grasp quickly its general outlines of production and management, to understand those shades of difference in cultural practices which are made necessary by slight soil variations, previous history of a field or some other feature, and to appreciate the reasons for growing different crops or different varieties of crops in slightly different situations in the same district. Altogether he would acquire a good deal of local knowledge without which an extension worker is bound to limit himself either to generalities on the one hand or to small technical details on the other.

Promotion to the post of District Officer should not be expected under the age of thirty years. It is a job for a mature, experienced man of suitable personality and should carry salary, status and conditions comparable to other departmental positions likely to attract such men. This would mean, say, a salary of £550-£650 a year, departmental house at reasonable rental and a departmental motor vehicle.

Following appointment to a district, extension officers should be encouraged to define problems for investigation and to keep in close touch with such investigation. Probably each district officer will have a major specialty in conformity with the most important industry of his district. It is, however, not too much to expect him to be adequately informed on most of the other activities, so that he may be generally helpful to the producers who have themselves to be men of many parts.

Qualifications and Work of a District Officer.

Agricultural and Pastoral Areas. Qualifications of a district officer for agricultural and pastoral areas are:

- (1) A sound knowledge of the crops of the district and considerable experience in their production and handling.
- (2) A real appreciation of the soil, natural timber and climatic conditions and what with reason can be attempted where.
- (3) Close contact with current investigational work.
- (4) As well equipped on the pasture side as for crops, particularly as regards what can be done with improved management of natural pastures and possibility of improvement by top-dressing and sowing down. He should be particularly strong on the most economic methods of sowing introduced species and where short cuts can justifiably be attempted. A sound knowledge of weeds and weed seeds would also be of value.
- (5) On the stock side, he should be at home with problems of breeding, feeding and management, and well aware of the significance of the phenotypic points by which many breeders set such great store. It is not too much to expect him to be a fair hand at sheep classing.
- (6) The rôle of pastures in the nutrition of stock and arrangements for supplementary and total feeding are important. Many troubles with sheep are due to physiological disturbances and may be prevented by appropriate precautions in providing suitable supplementary feed.
- (7) A good working knowledge of vegetable and fruit growing to assist people with their homestead gardens would be useful.

Suggestions concerning his work are:

- (1) As he will not visit every one in the district every year, he can have a fairly large district, say, 2,000 properties.
- (2) Routine visits should not be made, though he should try to contact farmers in a section of the district which he has been asked to visit. It is a sound principle that he should postpone visiting properties until he is asked; but when he does make a visit he should do it properly.
- (3) Topical and seasonal articles in district newspapers and radio talks are all well worthwhile activities, in which he should have complete freedom.
- (4) He should be available for consultation at district centres at appropriate times, e.g. market days.

- (5) Assistance in organizing district activities should be part of the job.
- (6) He should be the channel through which arrangements for visits to the district by specialists are made.

Dairying Districts. In dairying districts, extension work by a District Officer is necessary, together with specialized instruction by Dairy Officers who, in addition, would be inspectors under a State supervision and/or Dairy Produce Act.

The District Officer should hold a university degree in agricultural science and specialize in agricultural economics so that he could advise principally in improving production, helping herd test organizations, and assisting generally in the commercial economy of farming. Dairy officers would deal principally with instruction on the quality aspects of milk and its manufactured products.

Because they are principally engaged in inspection, dairy officers should be directed from a central dairy divisional office, but in the field should co-operate as directly as possible with the District Officer.

In order that advice given by dairy officers may be uniform and of the highest possible quality, a dairy manual similar to that in use in New South Wales, but considerably expanded, should provide the necessary information. A copy of this manual should also be in the possession of every licensed dairyman.

An excellent opportunity of ensuring uniformity of quality of Australia's dairy products would be for all States to adopt a common code for use in instruction and inspection of all dairy and factory premises. A code similar to that recommended by the United States Public Health Service and published in Public Health Bulletin No. 220 could be drawn up by a committee of experts, both departmental and commercial, from all States working under the Director-General of Agriculture of the Commonwealth. This code could be adopted by the States and incorporated in their own laws. Such a system would ensure better administration, better quality of products and greater uniformity of one of Australia's biggest local and export industries. This would be the best method of educating the farmer in dairy hygiene for his own benefit.

Horticultural Areas. In the horticultural industries, extension is conducted by officers who combine the duties of inspector and instructor. There are occasional visits to orchards by specialists. Too much reliance is placed upon the instruction from inspectors; their qualifications are not high enough and they are not always welcome in this capacity. There is an absence in the field of scientifically trained officers. The alternatives are more activity among orchardists by specialists from headquarters and higher qualifications for inspectors, or divorce of inspection from instruction and appointment of instructors with necessary qualifications. Appointment of district horticultural extension officers of relatively high scientific standing and the divorce of instruction from inspection are recommended on the assumption that, at the same time, research to provide a much stronger experimental background for advice in horticulture than at present exists will be undertaken, and that a liaison will be established between the investigators and instructors.

In addition to instruction in ordinary orchard technique to backward growers, the duties of instructors should include (a) extension of results of research by confirmation, demonstration, the Press and personal contact, and (b) correlation of growers' practices and of tree and soil conditions in their areas, and the sharing of the results with research officers.

Except where an instructor may himself be a District Officer, as perhaps in the Goulburn Valley, instructors should be subordinate to District Officers. In some instances, instructors could be shared by more than one District Officer.

Research Stations in Extension Work. It is not suggested that the Department of Agriculture should be only an extension organization. There will always be specific problems for it to investigate and the application of results of research work conducted elsewhere will require considerable working-out. Those actively engaged in investigational work are usually the first to see possible local applications of new knowledge.

These requirements of facilities and staff are best met by research stations, which have also another, but very definite, contribution to make in providing centres and facilities for the training of extension officers.

Already by means of organized field days and demonstrations at research stations, good extension work is being done. Improvements in results being obtained now might be achieved by not attempting to crowd too much into a limited time. The suggestion is made that different days might be devoted to special activities, such as agronomy, pastures, poultry and sheep husbandry. Questions to the demonstrator from the visitor are most important and useful and time should be given for these.

Special mention should be made of the fact that in Victoria farmers have come to appreciate the necessity for the complex replicated design of experimental plots for accurate investigational work and no difficulty has been encountered in using such plots for demonstration purposes.

Publicity. Finance granted for departmental publicity has been totally inadequate and operations in this field have been limited accordingly. It is suggested that a Division of Publicity be established under a superintendent equal in status to the superintendents of agriculture, live-stock, dairying and horticulture. The staff should include graduates in agricultural science with experience in journalism. Obviously such an organization cannot be built up overnight, but a nucleus should be established immediately and gradually extended. Its operations would include the following :

- (1) *Publications.* (a) *Journal of Agriculture.* This is well produced and compares more than favourably with similar interstate official publications. It suffers from inclusion of professional papers of principal interest to research workers. It is suggested that the journal should deal solely with matters of interest to primary producers and that professional papers should be published separately. Reorganization of the system by which contributions are made is desirable.
- (b) *Leaflets and Bulletins.* These are principally reprints and revisions of articles, which have already appeared in the journal. The system is economic and generally effective. These publications would be improved and increased in number as the journal expanded, and with the operation of the new divisions. However, the modern technique which is revolutionizing educational propaganda should replace the obvious official stamp.
- (2) *Press Statements.* This work is well done and bears the hallmark of the trained journalist. A publicity division should prove valuable to enable senior departmental officers to maintain much closer touch with newspapers. Something in the nature of a regular informal press conference might well be adopted to keep newspapers informed on many phases of departmental policy and development. There should be a more positive approach by the Department to the Press ; organization of field days, tours and the like should include facilities to ensure adequate Press representation. In other words, the Department should exploit to the full the opportunities provided by the Press, and this should be done in a more personal way. The methods by which this can be achieved would follow naturally the appointment of trained staff with experience and initiative who would, among other activities, publicize the extension service. It should be emphasized here that the Press offers opportunity for employment of graduates in agricultural science, and those with aptitude for this work should be encouraged to enter journalism.
- (3) *Radio.* Radio has obvious limits. For example, it is a most unsatisfactory medium for technical detail. It is, however, of decided value in stimulating general interest and should be used in conjunction with other forms of publicity.
- (4) *Films.* The Department has pioneered this field, in which there is great promise. Every encouragement should be given to its extension.
- (5) *The Better Farming Train* provided a useful educational medium.

Extension Work by Other Government Organizations.

Council for Scientific and Industrial Research.

As its name implies, research is the main activity of the Council. Except by special arrangement with the State authorities, it does not undertake extension work in primary industries. Results of its investigations are published in bulletins and pamphlets which are prepared for the information of scientists generally and of extension officers rather than producers. In much of the criticism which has been levelled at the form of these publications, this point has been overlooked. Obviously in honouring its agreement with the State departments, the Council has no other course. Nevertheless as public documents these publications are available to, and are requested by, producers, and in this way the information available is extended. Examples of this are the soil survey bulletins which are freely used by producers in some districts.

Obviously in connection with investigations of agricultural and animal problems, considerable field work is necessary, and this requires for its efficient supervision field officers having many of the qualifications required in the District Officers, and for such appointments the work on which they are engaged may provide a very suitable training. On the completion of these investigations it may well be found

that the officers who have conducted the field work are the most suitable persons to instruct State departmental officers in the techniques which have been developed in their field of research.

In certain cases, by special arrangement with the State Department, they may undertake demonstrations and extension work to producers. One instance of such an arrangement is the work of Mr. N. P. H. Graham (of the C.S.I.R. Division of Animal Health and Nutrition) in demonstrating in New South Wales methods for the control of blowfly strike. Another will be seen in the extension work shortly to be undertaken on the Murrumbidgee Irrigation Area, also in N.S.W.

It has been suggested elsewhere (Rivett, David, *Aust. J. Sci.*, 5 (4), 1943, 125) that the extension services of the Departments of Agriculture "might well be staffed from C.S.I.R., in the main, the transfer being one involving promotion both in status and salary".

In our view it would be only from officers with good field experience with C.S.I.R. that successful promotions to field duties with State extension services could be made. Other C.S.I.R. officers might be used in these services as liaison specialists between the district officers and the research workers. Whether the liaison officer should be employed by the organization doing the extension or that doing the research work is a matter for careful consideration. Under present Australian conditions the decision would be influenced mainly by the number of suitable men available.

State Rivers and Water Supply Commission.

The Commission is required to instruct occupiers of land in the irrigation and water supply districts in the best methods of irrigated culture, of the utilization of water and in rural economy, and promote the discussion of matters of general interest among the settlers by public conferences. These functions are carried out by publication and circulation of information as to improved methods of irrigation, uses of manure on irrigated crops, and drainage of irrigated land, and by subsidizing competitions for irrigated crops, and for methods of control of irrigation water.

The Commission has also interested itself in the control of erosion because (1) in the Mallee the cleaning of windblown sand from the channels costs an average of £60,000 per annum; (2) water erosion in reservoir catchments will tend to reduce the capacity and usefulness. One reservoir, Lannecoone, has had capacity reduced from 14,000 ac. ft. to 7,000 ac. ft. approx. In its contra-erosion work the Commission has published articles and reprints, had made broadcasts and organized competitions.

State Electricity Commission.

To increase the use of electricity and the sale of electrical apparatus in rural areas, the Commission has engaged in extension work in the poultry and dairying industries.

Soil Conservation Board.

The functions of the Board include (1) dissemination of information with regard to soil erosion, soil conservation and reclamation; (2) instruction and supervision of land holders in matters pertaining to soil conservation; (3) assistance of land holders whose land has been affected by soil erosion; (4) carrying out of experiments and demonstrations in soil conservation and reclamation. As the Board was appointed after the outbreak of war and its chairman is absent on war service, it has not yet carried out these functions. It is apparent that it may become a potent factor in the extension work among land holders in this State.

Lands Department.

This Department contrives and administers land settlement advances to farmers, and control and destruction of vermin and noxious weeds. To carry out these

functions it has a staff of supervisors and inspectors who give advice and instruction on vermin destruction and weed control. Generally their duties are inspectorial and only in isolated cases on individual initiative do they carry out extension work. The fact that these inspectors are constantly and continuously in contact with the land users in their districts makes it obvious that their services could be used in extension work. The question is again the old one whether or not inspectors can also function usefully as extension officers. The contact that these men have, and the fact that as Crown Land bailiffs they visit remote settlers in official duties, indicate that their services could with advantage be used as extension officers to a greater extent than at present. This would involve the appointment of men with better agricultural training and a closer liaison between the Department of Agriculture and Lands than at present. It might also involve the transfer of vermin destruction and weed control to the Department of Agriculture. This would, however, still leave farmers' advances and the supervision of the alienation of Crown Lands with the Department of Lands, and this would require inspectorial staff. The latter of these duties particularly works well with inspection of vermin destruction and noxious weeds, and it does not therefore appear that it would be advisable to transfer the control of vermin and noxious weeds to the Department of Agriculture. On the other hand there should be more liaison between the various departments on these matters.

It is desirable that extension work by these agencies should continue, but that policy should be discussed with the Extension Division of the Department of Agriculture with a view to co-operation between local officers of all organizations.

Extension by Commercial Organizations.

Considerable extension work of variable worth will continue to be done by commercial organizations such as fertilizer companies, technical dairy services and vendors of spray materials. So concentrated, continuous, and therefore influential are these efforts that no responsible member of a government extension service should be ignorant of, or indifferent to, the subject matter involved and the claims made. On the principle that the more who convey the right messages the better, co-operation, where possible, with those responsible for this trade propaganda would seem desirable. It is also suggested that traders concerned with extension of reputable ideas based on principles of agricultural science be urged to give preference, for substance and direction at least of these, to scientifically trained officers.

Organized Farmers and Extension.

In other States special officers have been appointed to organize groups among land users for the reception and distribution of knowledge and to act as local committees. In Victoria until the formation of the War Agricultural Committees, any organizing which has been done has been by officers engaged on other work. The land users themselves are organized in various ways, some of these organizations deal only with improvement in agriculture, others are purely marketing or protection organizations, whilst others may combine both functions. Examples are as follows :

(1) The *Chamber of Agriculture* consists of representations of contributing agricultural, pastoral, horticultural, viticultural and kindred societies and associations and dairying companies, together with individual members approved by the Council and Honorary Life Members. The objects of the Chamber are generally to watch over, promote and protect the interests of rural production, and to improve and extend the agricultural, pastoral, horticultural, viticultural and kindred industries in the State. It therefore may be said to be an organization which all persons liable to benefit from agricultural extension are eligible to join. It could therefore be used as a medium for the extension work, but its large size, infrequent meetings, and the variety of interests represented indicate that it is preferable for the Department of Agriculture and other departments to work directly with the organizations which are members of it. These will be dealt with in their order.

(2) *Agricultural Societies* comprise the Royal Agricultural Society centred in Melbourne, and agricultural societies throughout the country. The main function of the agricultural societies has in the past been the holding of an annual show for live-stock, produce, and the like, but many societies have taken an active part in improving agriculture generally by holding competitions of various types (crop and fallow, pasture, lucerne) and by organizing lectures by departmental experts. At one time, agricultural societies received subsidies from the State Government, but these were discontinued about twenty years ago. Failing any definite organization by State officers it would appear that a renewal of these subsidies would be of distinct benefit.

(3) *Breed Societies*. Organizations of owners of particular breeds of sheep, cattle, horses and poultry are mainly concerned with the welfare of their own breeds, but could be used in extension work.

(4) *Herd Test Associations* function mainly in the work that their name implies but they have also, at times, organized lectures by Departmental specialists and competitions for various types of crops. The Victorian United Cow Test Association is a central organization of these societies. It has conducted a State Dairy Farm competition from which much useful information was obtained. It could be used in extension work.

(5) *Fruitgrowers* are organized in a number of associations.

(a) In the Goulburn Valley each district has an association, and these are combined into the Northern Fruitgrowers' Association. Although these associations combine with the Department of Agriculture in arranging demonstrations of pruning and pest control, and also at times arrange for dissemination of information, they mainly act as watchdogs of the industry negotiating with the canneries and agencies in marketing, with the Government on such matters as sugar control and cannery prices for fruit, and with the labour organizations in working conditions.

The canneries in the Goulburn Valley are co-operative, and as such could take a part in extension work. Although they co-operate with the Department of Agriculture in circulating information regarding spraying periods and mixtures, they do no other extension work.

(b) The orchardists in other districts are combined in local associations, many of which are co-operative owners of cool stores. These local associations are combined into Orchardists and Fruit Cool Stores Association of Victoria, which holds an annual conference at which talks on topical scientific subjects are given. The main objects of the Association are marketing and protection of the industry.

(6) *Citrus growers* are organized in the Victorian Central Citrus Association. Although the objects of this association are mainly "protective" and marketing, it publishes a paper, *Citrus News*, which contains articles of scientific value, and which is a useful medium for extension work.

(7) *Dried fruit growers* are organized into local branches of the Australian Dried Fruits Association, which is mainly a marketing body. It has, however, co-operated with the Department of Agriculture and C.S.I.R. in extension work and publishes *Dried Fruit News*, in which scientific articles are frequently published.

(8) *Wheat growers*. In addition to the agricultural societies, wheat growers are organized in the Wool and Wheat Growers' Association, which concerns itself almost entirely with marketing and similar problems.

(9) The *Graziers' Association of Victoria*, which is a protective organization, has also provided a useful extension service to its members. This includes information from a veterinary surgeon. Professional services of graduates in Agricultural Science have also been sought in preparing information.

(10) *Victorian Dairymen's Association* concerns itself with marketing and similar problems.

(11) *Co-operative Butter Factories* have the improvement of the dairy industry at heart and their goodwill could be exploited to a greater extent.

In view of the weaknesses attaching to the Farm Bureaux system, we are of opinion that the organizations enumerated above could be used efficiently by District Officers in various phases of extension work.

UNIVERSITY AND POST-GRADUATE AGRICULTURAL TRAINING.

Recruitment of Suitable Undergraduates.

It would be good to have a steady flow of good students with a farm background, both for extension and research work. Indeed, such a background is almost essential for the extension worker. This must involve not only an improvement of school education in the country, but also encouragement to undertake the university course, in the form of adequate financial aid to cover the cost of board in the city.

Similarly, there should be encouragement to promising students from agricultural colleges to pursue the university course. The assistance proposed above for country

students might be extended to cover graduates of agricultural colleges. In addition, the establishment of one or more scholarships tenable only by these students is desirable. However, in Victoria there is some doubt whether any but an occasional outstanding graduate of the agricultural colleges could benefit fully from university education. Our proposals presuppose that the standard of these diplomatists will improve in the next few years.

The Undergraduate Course.

The structure of the undergraduate course has been reviewed in relation to the requirements of extension workers, research workers and school teachers in agriculture; employees in business and industries related to agriculture; and persons proposing to farm on their own account.

Extension Workers. The agricultural graduates of Melbourne are largely absorbed as extension and investigational workers in the Victorian Department of Agriculture and the agriculture course was designed with this end in view. A training of the present academic standard is considered desirable to enable the extension officer to consult the scientific specialist and to hand on new knowledge to the farmer. The course gives a broad and general training, well suited to the requirements of the extension workers. However, it would be improved by giving greater weight to live-stock problems, and the importance of these in our opinion justifies the appointment of a full-time lecturer in animal husbandry. The practical training has been given inadequate attention in the past, and the course held at Werribee until 1942 was unsatisfactory. The present course at Dookie provides more than twice as much practical experience and promises to come up to requirements. In general the course is well suited for prospective extension workers.

Research Workers. We realize that no undergraduate course can turn out a graduate capable of immediately undertaking individual research.

The issue has been raised, whether the intending research worker should specialize during the final years of his course or whether he should do so after graduation. Specialization cannot be achieved without the research man sacrificing his general training. This training must subsequently provide him with the background necessary for the appreciation of the wide implications of his particular field of work. Furthermore, the amount of time that could be devoted to specialization during the final year or years is relatively so small that the graduate would still require post-graduate training in his chosen subject. Accordingly, no attempt should be made to enable greater choice of subjects during the final years of the course.

School Teachers. The course in agriculture is an excellent training for teachers in general science and biology as well as agriculture. At present there is no other course that turns out men who can teach general science. Further, agricultural graduates should be particularly valuable in raising the standard of teaching in the country.

It is highly desirable that the Education Department should make arrangements for allowing student teachers to take the agricultural course as part of their general training in lieu of the science and arts courses usually taken. It is understood that teachers may nominate for the course at present, but the length of the course and the additional cost of the practical year discourages prospective students. Administrative action by means of larger allowances is recommended to overcome the latter difficulty.

It is suggested that a three-year course, with no practical year, for a degree in science might be given to overcome the difficulty of the length of the course. Nevertheless, to offset the loss of the practical year, a prospective student would be expected to have had some years of rural experience and be prepared to spend his vacations during the university course on rural work. It is considered that this would give a suitable background to a teacher of an "area" or a "rural" school.

In view of the probable development of "area schools" this question of training suitable teachers should be given every consideration.

Employees in Business and Industries Related to Agriculture. The types of employment under this heading are too numerous for individual consideration. Examples are land valuers, journalists, food technologists, superintendents of irrigation districts, and salesmen of agricultural machinery, seed and manures, spraying materials.

It is considered that the course provides adequate general training for these occupations, although it would be desirable for the land valuer to have made further studies in agricultural economics, and the irrigation district superintendent in agricultural engineering. The journalist requires practical training in a newspaper office and a study of the law affecting journalism.

Persons Proposing to Farm on their Own Account. While the course is not, and should not, be designed to teach the practice of everyday farming, it can have a valuable place in training agriculturists who can be leaders of scientific technique in their districts.

Post-Graduate Training.

An extension worker can become qualified for his work only by field experience. It has been proposed, however, that the extension worker in general agriculture might benefit from spending a year on field research work, e.g. on surveys with the Soils Division of C.S.I.R., or on pasture research at the Waite Institute as an alternative to one year of the present training on the research stations in the Department of Agriculture. The committee considers that this form of post-graduate training for extension workers is worthy of close consideration, both for its technical value and as a means of encouraging a closer liaison between research workers and extension workers.

It is visualized that the existing District War Agricultural Committees will continue as a post-war extension and planning organization. The staff requirements of these committees would be essentially of men of extension training; the establishment of a liaison with research workers would remain a desirable development.

In the case of research workers, post-graduate training should be regarded as a necessity. With University Schools of Agriculture of the limited size found in Australia, it is obviously impossible for each university to provide adequate post-graduate facilities in all subjects. Accordingly it is recommended that the particular fields of work developed at each school should be fully exploited. It is desirable that there be a mutual recognition of post-graduate training between the Australian universities. Thus a graduate from, say, Perth, might take his honours year in Plant Pathology in Sydney or in Soils in Adelaide. Financial aid to enable this to be done might be given from the Commonwealth Universities Research Fund.

It is recommended that diplomas be issued for two years' post-graduate study of specified courses in Agricultural Economics, Agricultural Engineering, Dairy Technology, Animal Husbandry and Soils. Alternatively, students could undertake a combined course and obtain the ordinary degree and the chosen diploma at the end of five years. Again, the combined course could be extended to six years, in which case the saving in overlapping should make it possible for the student to carry out some research work in the final year, and possibly qualify for the master's degree.

Refresher Courses.

Since it is difficult for an extension officer, especially if stationed in the country as should be the case in most instances, to keep up with scientific advances, refresher courses should be arranged by collaboration between the Universities, the C.S.I.R., the Departments of Agriculture and other interested bodies. At these courses recent advances could be explained and discussed. (The blow-fly strike control course held at the Sydney University animal husbandry farm by arrangement between the C.S.I.R. and the N.S.W. Department of Agriculture is an example of the successful use of this type of education.) Every opportunity should be taken to make such courses include both instructors and officers for all States. It is absurd that agricultural scientific and extension work should be so closely segregated into States as is the case to-day. Such courses should enable instruction by the leading authorities in Australia and New Zealand on the particular subjects under discussion.

These courses should be regarded as an essential part of a man's work for his Department and he should receive travelling and living expenses. It is suggested that each extension worker could profit from refresher courses of a couple of weeks every two years.

Exchange of Workers between States and with New Zealand.

The opportunities for widening and developing the viewpoint of both research and extension worker by the interchange of workers between organizations have been grossly neglected. There should be a frequent interchange of workers, especially

of younger men, between State Departments of Agriculture and between the Universities. The scope for exchange with New Zealand has never been recognized officially, despite the great opportunities open. It is considered that in most instances twelve months would be a suitable period of exchange.

**Minority Report by Dr. J. S. Hosking and Mr. C. M. Donald
on the Undergraduate Course.**

The Australian University course in agriculture has been steadily expanded to meet current scientific developments by the addition of further subjects. The principle followed has been to teach graduates every subject that might reasonably be regarded as falling within the broad field of agricultural science. We consider that a point has been reached at which the course is severely overloaded. The undergraduate is deprived of the opportunity to explore any of the subjects beyond the boundaries of his lecture notes or set laboratory work. The student learns by rote, having no opportunity to do otherwise, and at graduation is sodden with facts and sterile of ideas.

Reorganization of the course is desirable. The ever-widening application of agricultural science, with the consequent definition of more and more specialized fields, must lead to the inclusion of ever more subjects or phases of subjects within the course. Concurrently the amount of time spent on each subject becomes, of necessity, less and less. The logical solution to this development must be a recognition that agricultural science has become too extensive to permit its treatment as a unified and standardized subject of study.

The Faculties of Engineering provide a suitable comparison. Engineering is a more specialized field than agriculture, and the range of occupation of engineering graduates is certainly no wider than that of agricultural graduates. Yet in all the Australian universities the Faculties of Engineering have adopted the principle of specialization during the final years of the course, i.e. Civil, Mechanical, Electrical and Mining Engineering. In English and American universities, specialization during the undergraduate's course in agriculture has been adopted for many years.

It is recommended that the Australian University course in agriculture be redesigned with two principles in view: the provision of opportunity for choice of subjects in the final years and, concurrently, a lightening of the set work to enable the student to develop initiative of approach. Because of the limited number of students and the limited staff in the schools of agriculture, it is considered that provision of opportunity for choice of subjects giving a bias with two principal fields is all that can be attempted initially. It is suggested that a student should have opportunity to select subjects giving a bias towards chemical and physical aspects of agricultural science (e.g. biochemistry, soils, agricultural chemistry, etc.), or, on the other hand, to biological aspects (plant pathology, genetics, entomology, etc.).

The immediate objection raised by opponents to bifurcation of the course is that whatever phase of agricultural science is followed by the graduate, he still needs the background provided by the present uniform course, and that any specialization will lead to a serious loss in his appreciation of the relationship of his particular subject to general agriculture. We would stress that provision of opportunity for choice of subjects need involve no such danger. The early years of the course would be attended by all students, and even in the final years certain subjects would be compulsory for students pursuing either the biological or the chemical and physical aspects of agricultural science. The need to preserve the width of viewpoint of the present-day agricultural graduate is paramount.

The scope for the adoption of specialization in the final years is obviously greater in faculties in which four years are spent in attendance at university lectures and a year of practical experience is an added requirement (e.g. Sydney) than where one of the four years is spent in practical training (e.g. Melbourne): Nevertheless, opportunity for choice of subjects still remains.

The intending research man will obviously benefit from his greater study of subjects more directly related to his future field of work. The fewer number of subjects on his curriculum will give him time to think as well as to learn.

The extension work will be of two types—the consultant on all problems likely to arise in general farm practice and the specialist adviser who has to advise on specific problems. The latter would select subjects with a bias towards his proposed field of work, while the general adviser would be able to spread his choice of subjects so that he took subjects from both the chemical-physical group and the biological group. (In regard to general extension work, of which the requirements are, if anything, more exacting than for research work, we consider that use should be made of a combined training at an agricultural college and a university.) School teachers, students intending to enter business life, or to go farming would, in the majority of instances, select subjects from within each group.

Summary.

Primary Education. The ambitious syllabus for agricultural science in primary schools is rarely achieved because of lack of time and of trained men. In our view the attempt is a waste of time and such teaching should be limited to "farm arithmetic", economic plants and agricultural aspects of economic geography. Initiative should be encouraged by handicraft subjects and Young Farmers' Clubs. We look forward eagerly to area schools, but too much should not be expected of that system in teaching agriculture. Results will depend on a well-trained and adequately paid teaching service and on modern equipment.

Secondary Education. In secondary education the good work can best be continued by a broad general science course. Agricultural colleges should be designed primarily to educate for farming the sons of families already engaged in the industry. Students should be accepted at 13 years with merit certificate. The course should be of four years, of which the first two should give general education. In addition to the college diploma for successful completion of the four years course, there should be short post-graduate courses in special technical subjects, such as dairy supervision, and more use should be made by the State of college graduates as technical officers. It is recommended that the colleges be administered within the Department of Agriculture, with the assistance of an advisory board representing the Department of Agriculture, Department of Education, the University of Melbourne, and the Chamber of Agriculture. Given post-graduate training for one year in teaching, university graduates in agricultural science could adequately staff the colleges.

Extension Services. Victorian extension services to primary production are generally inadequate, and suffer from lack of that drive and direction which can best come from a central organization appointed with that specific purpose. The need for specially trained resident District Officers is equally apparent.

The State extension service should be a separate division of the Department of Agriculture. Resident District Officers should be appointed. These should be university graduates in agricultural science who, after graduation, have had at least five years' practical experience in the special section of agricultural activity selected, as for example agronomy, horticulture, dairying. Assistance in other branches would be provided where necessary.

The post of District Officer is one for mature, experienced men of suitable personality and should carry salary, status and conditions comparable with other departmental positions likely to attract such men. The report sets out the qualifications of a District Officer for agricultural and pastoral areas, dairying districts and horticultural areas, together with suggestions concerning his work.

Research stations provide centres and facilities for training of extension officers and for organized field days and demonstrations, by which good extension work is being done.

Finance granted for Departmental publicity has been totally inadequate and operations in this field have been limited accordingly. It is suggested that a Division of Publicity be established under a superintendent equal in status to the superintendents of agriculture, live-stock, dairying and horticulture. The staff should include graduates in agricultural science with experience in journalism. There should be a more positive approach by the Department to the Press.

The report reviews the extension work conducted by other government organizations which, it is urged, should discuss policy with the extension division of the Department of Agriculture to achieve co-operation between local officers of all organizations. Where possible there should be better co-operation between the Department and commercial organizations which undertake considerable work of this nature.

In view of the weaknesses in the Farm Bureaux system, we are of opinion that the present Victorian organizations of farmers (enumerated) could be used efficiently by District Officers in various phases of extension.

University and Post-Graduate Training. Recruitment for university training of suitable students with farm background involves improvement of rural primary education and adequate financial aid to undergraduates. In general the course at Melbourne University is well suited for prospective extension workers, but could be improved by giving greater weight to live-stock problems and appointing a full-time lecturer in animal husbandry. No undergraduate course can turn out a graduate capable of immediately undertaking individual research, and it is not considered that the course should be modified to allow the intending research worker to specialize in the final years of his course. (A minority report is submitted on this subject.) In view of the probable development of area schools, arrangements should be made by the Education Department to allow student teachers to take the agricultural course instead of science and arts courses usually taken. It is considered that the course gives adequate general training for occupations in businesses and industries related to agriculture.

It is recommended that wider opportunities for post-graduate training be provided and that, for intending specialists, diplomas be established for two years' post-graduate study in certain special subjects. Refresher courses should be arranged. Opportunities for widening and developing the viewpoint of both research and extension workers by interchange of workers between organizations have been grossly neglected.

The Future of Wool*

I. DEVELOPMENTS IN SYNTHETIC FIBRES

By

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The writer has been interested in the development of the modern synthetic fibre from the time of its introduction as a definite substitute for wool by the Axis countries about thirteen years ago, and in his presidential address to the Royal Society of New South Wales in 1936, special reference was made to the seriousness of the position at that date. Mr. A. E. Heath, when Agent-General for New South Wales in London about the same time, observed these rapid developments as a result of periodical visits to the Leipzig Fair. He was subsequently confronted with a demand for his recall when he sounded a timely warning about the possible adverse effects of these substitutes upon our wool industry. Events have moved swiftly since 1935, and so have technological developments in synthetic fibres, an achievement which Dr. E. F. Armstrong, F.R.S., Scientific Adviser to the Ministry of Home Security, Great Britain, classified recently as World Wonder No. 2, when suggesting that the architectural wonders of the world should be replaced with the technical wonders of the world.

It is proposed, as briefly as possible, to survey these developments which, incidentally, are believed to be only in their infancy.

Staple Fibre.

Staple fibre first came into prominence in 1930 when Germany began to make it from beechwood and spruce timbers as a substitute for wool. The other totalitarian countries entered the field a year or two later. There has been a marvellous improvement in quality year by year, together with a very steep increase in production from seven million pounds weight in 1930 to over one and a half billion pounds weight last year (1942).

Only four countries were originally engaged in this manufacture, but thirteen or more, including Great Britain, are now producing it. This wood fibre makes excellent textiles when mixed with wool, rayon or cotton. A crimp has also been introduced which helps to retain the body heat. Wood or staple fibre is now extensively used, either alone or in admixture with wool, in the manufacture of all types of woven fabrics, including knitted goods.

Some idea of the size of the factories in Europe may be gauged by the annual output of one in particular, the fibre from which equalled what we would obtain annually in wool from six million sheep.

Germany (35 per cent.), Japan (28 per cent.) and Italy (25 per cent.) produced 88 per cent. of the world's total of 623 million pounds in 1937. Although the stupendous production of staple fibre during the past 13 years must have made heavy demands upon the forests of Europe, notably Scandinavian, vast sources of suitable timber, as yet untapped, are still available for future exploitation.

Lanital and other Fibres from Casein.

When sanctions were applied against Italy in the Abyssinian conflict, some use had to be found for the casein from skim milk which had formerly been converted

* "The Future of Wool" was the general title under which addresses were given by Mr. A. R. Penfold and Dr. I. Clunies Ross at a combined meeting of the New South Wales Branches of the Australian Institute of Agricultural Science and the Australian Veterinary Association, held at Science House, Sydney, on 5th November, 1943.

into Gorgonzola cheese. Dr. Ferretti, the inventor of Lanital, succeeded in producing a fibre which resembled wool very closely in chemical composition, with the exception perhaps that it contained a little more sulphur than wool. The original samples were very poor, possessing only 10 per cent. the strength of wool. Steady improvement had been effected yearly since 1935, with the result that today this fibre approximates very closely to wool. An excellent textile is made by admixture of 50 per cent. wool with 50 per cent. Lanital. Great Britain today is producing about one and a half million pounds weight of this fibre, despite the fact that milk is an important foodstuff. The United States of America is producing five million pounds weight per annum, equivalent to the recoverable casein content of about 160 million pounds of skim milk.

It is difficult to visualize the economic exploitation of skim milk for fibres in Australia, although there are occasions when there is a surplus of skim milk which is allowed to run to waste. Nevertheless the significance of the utilization of dairy by-products is potentially important in the economy of dairy farming, and anything that will assist in stabilizing the industry is worth investigation.

One of the great spinning organizations in the United Kingdom is making from skim milk a useful fibre which is being used in admixture with 50 per cent. wool. This manufacturer claims that fibre from skim milk possesses several important individual features which, briefly, are as follows :

- (1) It has a softening effect on coarse grades of wool, thereby improving the grade of wool.
- (2) Its plastic properties enable the blended yarn to take and retain pleats more readily than an all wool textile.

The Americans are marketing their material under the trade name of "Aralac". They claim that "Aralac" is more expensive than rayon and cotton, but cheaper than fur and wool. The fur industry was the first to utilize it because it was confronted with a scarcity of rabbit fur, coupled with rising prices. Today most of the fur felt and wool felt hats in the United States of America, Canada and South American countries contain about 15 to 20 per cent. of this fibre. The Australian manufacturers who have experimented with the material are anxious to use it as soon as supplies are available.

From information received it would appear that the material is excellent for knitting, and it is anticipated that, next season, American women will be wearing blouses, slacks and other apparel made from skim milk.

Nylon Fleece.

The story of Nylon fibre has been told so many times that no useful purpose would be served by repeating it here. It is well known that Nylon possesses a degree of elasticity and strength which has so far not been surpassed by any other fibre, either natural or artificial. In the manufacture of hosiery from Nylon a certain quantity of apparently useless waste results, i.e. short ends, spool leavings, etc. This material is being marketed in both the United States of America and Britain as Nylon fleece. It possesses a crimp and has the general physical appearance of wool. So far it has been made up in the form of women's coats for sale in America and the United Kingdom.

Whilst this development has not yet made its effects felt in Great Britain or in Australia, it has far-reaching possibilities which should not be ignored. Nylon is a fibre which is made by a series of intricate chemical reactions from carbolic acid, a group of products resulting called polyamides. The achievement of Dr. Carothers and his co-workers in establishing the chemistry of these new polyamides has laid the basis for the syntheses of an almost unlimited number of allied substances, and

there is no telling just where the ingenuity of the organic chemist might lead us. The possibility of making other synthetic fibres comparable with Nylon must also be considered because, as mentioned previously, the industry is only in its infancy.

Soya Bean Fibre.

The manufacture of a fibre from the protein of the soybean has been under investigation in Japan and the United States of America for a number of years. Just before the outbreak of war in the Pacific in 1941, a series of textiles made from soybean fibre was received at the Sydney Technological Museum. They were examined and found to contain no other fibre than soybean. They were of excellent quality. Since the receipt of this collection it has been learned that remarkable progress in the technical application of the fibre has been made by one of the progressive firms in the United States of America. This company planted about 30,000 acres of soybean for its own use, intending to use it for automobile upholstery. The outbreak of war, however, caused the present production of 5,000 pounds of fibre per day, to be commandeered for blankets, overcoats and, experimentally, for some uniform suitings.

A remarkable feature of this development is the increase in the tensile strength of the new fibre to within 80 per cent. of that of wool, and the introduction of a permanent crimp at will. Excellent textiles have been produced by blending it with both wool and rayon. This amazing development is a classic example of combining factory and farm production, an economic feature of considerable post-war interest, and one that should be investigated by agricultural interests in Australia.

The American company claims to produce the fibre at half the cost of sheep's wool. About 400 pounds of soybean protein suitable for fibre is obtained from two acres of land. It should be noted, however, that this land under sheep grazing in the United States of America would yield only 8 to 10 pounds of wool as against 18 to 20 pounds in Australia.

Properties of Wool and of Synthetic Fibres.

The outstanding characteristics of wool are tensile strength, resistance to bending and its thermostatic and hygroscopic properties. Until recently most synthetic fibres, especially when wet, suffered from the disability of a lower tensile strength than wool. This has been overcome to a considerable extent by increasing the dry strength of modern synthetic fibre so much that even when wet the tensile strength is greater than that of wool. The property of brittleness or resistance to bending, although of importance to the durability of the fabric, is not of such outstanding interest in these days of rapidly changing fashions. Most synthetic textiles, especially those containing a proportion of wool, will meet all reasonable demands made upon them. The important thermostatic and hygroscopic properties of wool have been minimized to a considerable extent by modern conditions of living, including motor cars, buses, heated trains, central heating of houses and hotels, air conditioning, etc. Wool also has been noted for its superior felting properties, but today this property is not confined to wool alone.

Although technologists have not yet succeeded in reproducing the molecular structure of wool, considerable success has been achieved in imitating some of its structural characters, such as crimp and surface serration, with the result that admirable textiles are made by admixtures of these synthetic fibres with wool. Reliable authorities have stated that admixtures of up to 60 per cent. of staple fibre with wool when placed in juxtaposition with similar fabrics made from pure wool have been wrongly identified even by buyers and manufacturers.

Synthetic fibres likewise possess some advantages to which attention should be directed. There is no question that control of manufacture and control of output are very important economic factors. Control is therefore exercised over the form, the fineness and general uniformity and even the processing of synthetic fibres—such treatments as scouring and carbonizing are not necessary. Incidentally, too, most of the staple fibre produced today can be processed on standard cotton machinery. Another important factor is that there is little or no difference in price between the various grades of synthetic fibres, whereas there is a marked difference in price between fine and coarse wools. Synthetic fibres are not subject to seasonal fluctuations, and other natural influences. This aspect is well illustrated by the fact that in Great Britain, industrial production of the woollen textile industry has often been paralysed over periods of months on account of the uncertainty of raw wool prices. Price stability has tremendous economic advantages which staple fibre possesses and wool does not.

Synthetic Fibres and the Future of Wool.

It is not intended to discuss the question of prices, but since the staple fibre is so much lower in price than wool it must have a very serious effect on the future of wool. Other fibres, such as those made from skim milk and soybean, will obviously be dearer than staple fibre by reason of their origin.

It is difficult to visualize what the position of textiles will be in the post-war period. The future of synthetic fibres is certainly unpredictable. It can be said, however, that they have revolutionized women's dress and have given us an ever-widening range of attractive fabrics at prices to suit the pockets of all classes in all countries. The textile market appears to be an expanding one; the capacity of the world to absorb new fibres is unknown. An indication of the trend in Europe alone is the registration of nearly 200 new varieties of synthetic textiles, and the intensive research in progress is evidenced by the establishment of a special institute for the study of synthetic fibres at Breslau. One thing seems certain, however, and that is a low price for good textiles will certainly increase the demand for attractive fabrics in those markets which could not previously afford to buy them.

The following statement from a letter published in *The Sydney Morning Herald* of the 16th October, 1943, makes the position very clear regarding the future of wool, viz.:

"Wool has no future unless we tackle the problem immediately on the following lines:

"1. Discontinue the existing practice of exploiting the public by selling them inferior woollen goods at exorbitant prices. The position was bad enough before 1939, but has become much worse since.

"2. Only unshrinkable woollen goods to be marketed. Several good processes have been developed by Australian scientists during the past few years, and there is no reason why these should not be adopted generally by manufacturers. There is no valid reason why the singlet of today should be the collar of tomorrow.

"3. A planned investigation on the lines of the U.S.S.R. of all phases of wool production and its technology by a team of scientists and technologists. So far we have only tinkered with this work by using the services of two or three workers. An intensive investigation by at least twenty-five to thirty workers is essential. Only by giving the same concentrated attention to wool as others give to synthetic fibres will wool be saved from meeting the same fate as the majority of natural products.

"Publicity is sheer waste of money until we can offer unshrinkable woollen goods at low prices."

There is no need for pessimism about the future of wool if we can embark on a planned investigation of all phases of wool production and technology. If we can give the same concentrated attention to wool as other nations give to synthetic fibres, then no one can visualize what possible revolutionary results might come from it.

II. SAFEGUARDING THE FUTURE OF THE WOOL INDUSTRY

By

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In devising measures which might be taken for the protection of the wool industry from the competition of substitute fibres in the post-war period, consideration must be given

- (a) to the biological problems involved in improving the quality of wool and in lowering costs of production; and
- (b) to the problem of improving efficiency in the manufacture, salesmanship and promotion of wool goods.

The Field of Biological Research.

The problem of improving quality and efficiency of production of wool depends on the control of (a) the environment, and (b) the genetic or breeding material.

In regard to either of these, our knowledge is fragmentary and the scale of our attack on the problems involved is infinitesimal having regard to the magnitude of the industry and the dangers which confront it.

(a) *The Environment.* Though we are far from understanding fully the part played by nutrition, climate, etc., as compared with heredity in determining the nature of the fleece of the individual animal, it is undoubted that our existing strains of merino sheep have the inherent capacity to produce at least 50 per cent. larger fleeces per head than at present. Recent experiments by the Council for Scientific and Industrial Research have shown that an average run of strong wool sheep grew 18-pound fleeces and of fine wools between 13 and 14 pounds per head, when adequately fed under laboratory conditions.

The principal limiting nutritional factors are:

- (i) the quantity of food available; and
- (ii) the quality of the food, though here again individual sheep show wide variation in their ability as convertors of food into wool. Under identical conditions, one sheep may produce as much wool as another from 25 per cent. less food consumed.

We know also that in many instances accepted rates of stocking are such as to limit seriously the capacity of sheep to grow the maximum amount of wool of which they are capable. In these cases a reduction in the rate of stocking may not only lead to no loss of the total wool grown but also to a lowering of overhead charges for labour and disease control, while at the same time effecting a marked improvement in the composition of pastures.

(b) *Heredity.* Whatever the environment, the capacity of an animal to grow wool is determined basically by heredity. In Australia the improvement in the average wool clip per head proceeded steadily from about five pounds per head in 1880 to nine pounds per head in 1927. For the last 15 years there has been no significant improvement in the average size of fleeces, and opinion is divided as to whether there has been an improvement or decline in quality. The method of breed

improvement followed has been that of selection on the empirical basis of the appearance of breeding animals with reference in some cases to pedigrees, and for quantity of greasy wool of types apparently sought by buyers. It would appear that further improvement by such measures will be at best very slow and haphazard. The first essential to be sought is the general adoption of the principle of progeny testing, i.e. the determination of the quality of breeding stock, and particularly the *sire*, on the basis of the quality of his progeny and not on his appearance. Though the principles of progeny testing are now generally understood and widely applied in other countries they have been largely ignored in Australia, and no concrete examples can be given in this country of the results of their application. On the other hand, McMahon in New Zealand (Proceedings 9th Annual Meeting Sheepowners, N.Z., 1940) has carried out valuable preliminary work with Romneys. His conclusions are as follows:

- (i) To increase the average weight of wool cut by New Zealand Romneys from eight pounds to nine pounds per head would take 96 years if 50 per cent. of ewes were culled annually.
- (ii) If all ewes were kept but 97 per cent. of rams culled, 36 years.
- (iii) If all ewes were kept and 20 per cent. of the rams were progeny tested and the best 3 per cent. used on uncultured ewes, only four years.

In addition to progeny testing for gross wool production, it is necessary to test for clean scoured yield, density, length of staple, and evenness in fibre diameter and "handle". Such analysis of fleece character requires laboratory facilities to be available to stud breeders, though in relation to certain characters methods are being elaborated for rapid determinations which can be made on the properties.

Before a clear directive can be given to breeders it is necessary to have a much clearer appreciation of the significance of certain wool characters, as for example evenness of fibre diameter, in the manufacturing performance of the wool. The lack of accurate knowledge of such factors is shared by wool buyers and manufacturers, who in many cases are not conscious that the true quality of a wool cannot be determined by its naked eye appearances—e.g., a recent stud ewe purchased as a champion strong wool was found on microscopic examination of its fleece to be a fine wool, the appearance of the fleece being determined by a few strong fibres, which "set" the crimp into that of a strong wool.

The nature of the very important character "handle" is not understood either in regard to the physical characters of the fibre which determine good or bad handle, the method whereby these characters are inherited, or the influence of environment on them.

There is, above all, a very serious gap between the producing end of the industry and the manufacturers. The latter equally with the producer have in the past worked on empirical lines, and have little or no knowledge of the scientific bases which determine the performance and value of the fleece. In this particular the wool industry is at a very marked disadvantage when compared with the substitute fibre industry, which has been founded on and developed by intensive scientific research.

A Programme of Biological Research.

An intensive and extensive programme of field and laboratory investigations should be undertaken immediately into the following problems:

- (i) The nutritional value of Australian grasses and herbage in representative summer and winter rainfall areas.
- (ii) The influence of varying systems of sheep and pasture management
 - (a) on composition of pastures;
 - (b) on quantity and quality of fleece production;
 - (c) the economic return resulting from such varying systems of management and rates of stocking.

- (iii) The influence of environment on the productive capacity of the several main strains of merino sheep ; this should be linked with laboratory studies on the relative efficiency of different strains as convertors of food.
- (iv) The application of progeny testing of merino sires to fleece improvement in quantity and quality.
- (v) The value of artificial insemination in the rapid dissemination of the characteristics of proven sires.
- (vi) The elaboration of methods for the rapid determination of
 - (a) density ;
 - (b) evenness of fibre diameter.
- (vii) The determination of the physical and chemical factors affecting wool "handle", and the influence on these of
 - (a) environment ; and
 - (b) heredity.

The Link between Biological Research and the Manufacturing Industry.

It is essential that there should be a much more accurate appraisalment of the influence of the varying physical characters of the wool fibre on its manufacturing performance. The absence of such an understanding does not allow of any clear directive being given to growers as to the most desirable wool characters for which to breed ; buyers cannot be expected to recognize or pay more for wools having these characters, since they may not recognize or be conscious of them.

It is necessary therefore that there should be a very close link between biological research and the manufacturing industry, so that the former should be directed towards the production of fleece characters of definite commercial significance, and the grower and manufacturer be given proof of the higher value of wools possessing these desirable characteristics.

To provide this link it will be essential for experimental plant to be available to biological workers for scouring, carding, combing and spinning of wool from experimental flocks, with an adequate staff of skilled technicians for the control of the various processes.

Research into Processing and Manufacture.

The wool textile industry in the chief wool consuming centres has grown up throughout the centuries as a large number of small factories whose methods are based on traditions centuries old and who for the most part have not used nor felt the need to use science in their activities. For example, the British Wool Textile Industry, as a collective body, has only begun to call science to its aid in the last fifteen or sixteen years, with the establishment of the Wool Industries Research Association, with an income up to 1937 of about £10,000 a year. There was no comparable corporate research body in the United States, France or Belgium.

It must be appreciated that the wool manufacturer, unlike the wool grower, does not necessarily stand or fall by wool. He is interested in the manufacture of *wool-like* fabrics, and if these can be made by substitutes on wool textile machinery only a small number of manufacturers, from sentiment or tradition, would continue to use wool for its own sake.

The wool grower in defence of his own interests may therefore be compelled to play the main, rather than a subordinate, rôle in developing research in the wool textile production. It is necessary for someone—and if necessary the Government and growers of wool producing countries—to take corporate action to establish a research and promotion organization on the lines and on the scale adopted by the substitute fibre industries.

In association with the research organization it would be necessary to have an adequate promotion and publicity organization. Such an organization would maintain a close contact with the wool manufacturers, and with wholesale and retail demand for wool in all countries. It would make available information in regard to new developments in manufacture, submit new experimental fabrics and designs to manufacturers and the public, conduct sales and promotion campaigns and educational propaganda in regard to wool's special, and particularly its hygienic, qualities.

It must be recognized that however good the inherent properties of wool may be, its future must depend on its presentation to the public in such forms that these will be sought by the consumer as modern, attractively styled garments which can withstand the competition of equally attractive substitutes. Publicity to be successful must be based on the products of a modern and progressive industry, which is prepared to adapt or change its methods in conformity with fashion and consumer demand.

Not the least important function of the sales and promotion organization would be the development of latent demand for wool in new markets such as India, China, etc. The possibility of finding a market in these countries for a small range of standard products, mass produced at low cost, could be explored by such an organization in a way quite impossible for individual manufacturers.

In conclusion, it should be noted that a certain amount of research in all the above fields is at present being undertaken, as was promotion and publicity up to the war, by the International Wool Secretariat. In every case the staff, equipment and financial resources available are such as might be considered adequate for a minor industry in one country, but are hopelessly inadequate in relation to a world industry which is now facing the most severe and possibly decisive competition.

Steps Necessary to give Effect to the Foregoing Proposals.

To give effect to the above programme, the following developments should be undertaken immediately :

(1) *Australian Institute of Wool Research.* A central Institute of Wool Research should be established, preferably under the control of the Council for Scientific and Industrial Research, which should be charged with the duty of carrying out a comprehensive programme of research into all aspects of wool production—nutritional, agrostological, genetic and physiological. The Institute should exercise central control over co-ordinated field trials in relation to agrostology, progeny testing, artificial insemination, etc., and should have facilities for experimental processing of wool up to and including spinning.

Its field officers should work in association with State Departments of Agriculture, and their experimental farms. Subsidiary laboratories of the central Institute should be established in several States.

Arising from the work of the central Institute, State facilities should be provided for routine fibre examinations on behalf of local studmasters and stock owners, as these are induced to undertake progeny testing on their properties, on lines advocated by the central Institute and in the conduct of which the Institute's officers would, where requested, give their assistance.

To this end, Commonwealth funds provided for the work of the central Wool Institute should be made available to State organizations, such as the technical colleges and the Gordon Institute at Geelong, to enable the work of the Wool Departments of these institutes to be reorganized, and equipment and staff provided to enable routine services to be made available to local stock owners.

The central Institute should contain Departments of Nutrition, Agrostology, Genetics, Sex Physiology, Wool Biology, Statistics, Economics, Chemistry and Physics, with field staffs.

The annual appropriation required for the central Institute would be approximately £75,000, while financial assistance to the States for co-ordinated activities would be not less than £30,000 per annum.

The approximate annual expenditure on the complete national programme of biological research would therefore be £105,000 per annum.

(2) *Wool Textile Laboratory.* This laboratory would be responsible for research into every branch of processing and manufacture of wool. It would comprise the following Departments: Physics, Chemistry, Engineering and Technology, Designing, Dyeing and Finishing, Physiology and Hygiene, and an extension service to the Wool Textile Industry.

From a comparison with the expenditure of the British Cotton Research Association, it is considered that an annual appropriation of at least £100,000 would be required to allow of development on an adequate scale being reached in five years.

(3) *Promotion and Publicity.* Together with research facilities provided by the above organization, provision must be made for national and international promotion and publicity. The greater part of such funds should be expended in the maintenance and expansion of demand for wool in the great consuming centres, and in the development of demand in the potential markets, such as India and the Far East.

It is desirable that for such international wool publicity the three wool producing dominions, Australia, South Africa and New Zealand, should have available for joint purposes a sum of at least £500,000 sterling per annum. On the basis of existing contributions to the International Wool Secretariat, Australia's contribution would be £300,000 sterling (£A375,000).

The total expenditure involved in the above proposals would therefore be

(1) Institute of Wool Research	..	..	..	..	£105,000
(2) Wool Textile Research	..	..	..	..	£100,000
(3) Funds for Promotion and Publicity	..	..	..	..	£375,000
Grand total	..	..	..	..	<u>£580,000</u>

There would in addition be required a capital expenditure on buildings and equipment for the Institute of Wool Research and the Wool Textile Research Laboratory of approximately £500,000.

The above estimates are made on the assumption that the staffs employed for both biological and textile research will be of the highest scientific standing, and that equipment and plant will be entirely adequate for the most efficient prosecution of every branch of research involved. It cannot be too strongly emphasized that difficulty will be experienced in finding in Australia a sufficient number of men of the requisite standing to undertake direction of certain branches of the research proposed, and pending the erection of buildings and provision of equipment steps should be taken immediately to

- (a) explore the possibility of finding certain key men in other countries; and
- (b) select and train suitable personnel in Australia or send such men abroad for additional experience and training; and
- (c) investigate methods of research, sales promotion and publicity employed by textile interests and particularly synthetic fibre interests in other countries.

(Received for publication, 22nd November, 1943.)

The Economic Consequences of Agricultural Research

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About a decade ago, an argument frequently advanced to justify a particular line of agricultural research ran somewhat as follows. The value of the Australian production of a particular crop is normally, say, x hundred thousand pounds per annum. A particular disease may be estimated to cause, on the average, a loss of y per cent. of the crop. Therefore—the conclusion was rarely stated baldly but was implicit in the argument—research which succeeded in eliminating the particular disease would be worth annually xy thousand pounds to the country.

A logical consequence of this argument was that, assuming the scientific problems involved to be of comparable complexity, research was regarded as roughly justified in proportion to the existing monetary value of the production in the particular branch of agriculture concerned. In fact, agricultural research tended to concentrate, though not exclusively, on the great export products.

During and after the depression, when the prices of Australia's agricultural exports fell heavily, and schemes were put in hand to limit production, the above argument began to sound less convincing and was less frequently heard. A tendency developed for agricultural research workers to devote their attention more to relatively minor products, particularly those in which the country was not self-supporting and in which the fall of prices had been less severe. Concurrently, research was encouraged in secondary rather than primary industries. In discussing the effect of the depression on scientific research, Sir David Rivett (*J. Counc. Sci. Ind. Res.*, 7: 129, 1934) wrote as follows: "Nevertheless, one cannot ignore the bearing of present conditions upon the *raison d'être* of the C.S.I.R. and similar organizations. Suppose they suddenly wiped out all the possible causes, entomological, fungoid, and climatic, of loss in our apple orchards so that every tree produced a bumper crop. Is it not at least probable that the total price obtained for that crop, were it in gross excess of market demands, might actually be less than the total that would be given for a crop much smaller in quantity and just equal to or, better still, just a trifle below market demand?" Sir David went on to draw the logical, though rather melancholy conclusion, that more research should be devoted to the problems of gold production, gold being the one commodity of which the price was increased during the depression.

With the lifting of the depression, discussion of the subject again fell somewhat into abeyance. In agricultural research a rather haphazard balance has been maintained between the claims of different branches of agriculture. Within the C.S.I.R., for instance, work on wheat, a crop which suffered very severely in the pre-war decade, has been largely suspended, while, on the other hand, increased attention has been devoted to the problems of the grazing industry. The reasons for research to be concentrated on particular branches of agriculture are not always apparent, and it may be that, not infrequently, the willingness of the producers concerned to contribute towards the cost of a particular investigation is a major factor.

It is the purpose of this paper to urge the necessity for an investigation, to be conducted jointly by economists and agricultural scientists, into the economic implications of agricultural research, so that particular research projects may be

assessed, not only on their scientific possibilities, but also on their desirability in the broader economic background of national life. The notes which follow, admittedly tentative, attempt no more than to raise some of the problems which await investigation.

Economic Objectives and Applied Research.

In a recent discussion (Anon., *Economist*, Sept. 4th, 1943) of economic objectives the following sentences appear: "In the twentieth century, economic policy has three objects. They have been defined by Professor Pigou as being to increase the national income (the old policy of increasing the sum total of wealth), to improve the regularity of the national income and to improve its distribution among the individual members of the community."

It is clear that, within its limited field, agricultural research can make useful contributions towards each of these objectives. Probably the greater part of research in the past has been directed, consciously or unconsciously, towards the first objective. The aim has been to increase production per unit area, at the same time reducing the unit costs of production. The breeding of higher yielding varieties of crop plants is a good example of work of this nature. Some lines of research, while perhaps incidentally serving to increase the sum total of agricultural incomes, have as their more immediate objective the desire to reduce the seasonal fluctuations in income. Such are research projects designed to mitigate the adverse effects of drought, or to control diseases which fluctuate greatly from season to season. Finally, some work—that devoted more particularly to the problems of marginal areas and the marginal producer—may help to improve the distribution of the aggregate agricultural income among the individual members of the community.

While, as instanced above, successful research may promote more than one of the three economic objectives, it is perhaps less generally recognized that the three are not always mutually compatible, and it may be that the immediate effect, at least, of a particular line of research may be to aggravate inequalities of income. This will be made clearer if we attempt to consider the probable effect of successful research designed to reduce the unit cost of production of a major agricultural or pastoral product. In the first place, it is rarely, if ever, true that the results of agricultural research are equally applicable to all producers of the crop concerned. Almost invariably the solution of a particular problem will be applicable principally to a particular region or regions, as for instance, those in which the disease studied is especially prevalent. In so far as the application of the results of the research leads to increased production in such areas, it will tend, in greater or less degree, to depress the price of the product. This in turn will adversely affect the returns obtained by producers in other areas, and the marginal producers in such areas may well be faced with losses.

Further, the results will by no means be equally beneficial to all producers even in the areas to which it is particularly applicable. Application of the results of research to agricultural production usually, if not invariably, involves the producer in extra expense. This is true whether the measures recommended involve the reduction of disease by spraying, or increasing wool or meat production by the subdivision or top-dressing of pastures. Such extra costs may be readily met by the more prosperous producers, but the marginal producers may be in no position to pay out more money. They will thus be faced with the same difficulties as marginal producers in other areas, and the net result of the research may well be to favour the more prosperous farmers at the expense of the less prosperous ones.

Various possible objections to the above contentions may be examined briefly. They are, of course, concerned only with the *immediate* effect of the application of scientific methods, and it may be maintained that the long-period effects will be

THE
Journal of the
AUSTRALIAN INSTITUTE
OF
AGRICULTURAL SCIENCE

PUBLISHED QUARTERLY



VOLUME 9

1943

SUBSCRIPTIONS : Within Australia 10/6, British countries 11/6, Foreign countries 12/6 per volume of four numbers, and 3/6, 3/3 and 3/6 respectively per copy, post paid.

Issued Free to Members of the Australian Institute of Agricultural Science.

Registered at the G.P.O., Sydney, for transmission by post as a periodical.

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beneficial to the country as a whole and to all the producers concerned, as a result of the broader market obtained by the lower prices. In this connection, it will be well to recall Lord Keynes' famous phrase: "In the long run, we are all dead." It will be cold comfort to the marginal producer, faced with heavy losses and possibly forced off the land, to reflect that, if only he could have survived for a few more years, he might have been able to sell his products in China—if the Chinese could afford to buy them! In fact, of course, the marginal producer will not be content to die quietly; he will press for protection in the form of bounties, fixed prices, or in other ways. To discuss the consequences of this would involve consideration of international repercussions and would be out of place here.

It may be urged, too, that scientific advances are rarely sudden, and that their applications, partly owing to the inadequacies of the extension service, are too gradual to have any considerable effect on prices. These objections may be admitted, but it is not clear that they affect the above arguments except in degree, and it would perhaps be unwise for agricultural scientists to stress too strongly the relative insignificance of the results of their researches!

More fundamental is the objection that the adverse effects on marginal producers of the application of agricultural research will only take effect if the increased production envisaged does, in fact, influence prices. This involves considerations which come near to the heart of our problem, and on which a fuller investigation is urgently required.

Production, Prices and Research.

In the absence of a system of price control, it may be said that the effect on prices of increased Australian production of any primary product will vary according to the ratio of Australian production to the total marketed crop, and according to the elasticity of demand for the product concerned.

During the period prior to 1939, wool was the outstanding instance of a product in which Australia accounted for the bulk of the world's marketed production. A relatively small percentage increase in Australian wool production, whether due to research or other causes, would be likely to have a quite appreciable effect on world prices. In fact, a comparison of Australian wool production and prices before the war suggests that, on the whole, years of high production did coincide with low prices, and even that the total sum obtained by producers was less for a large than for a small clip. This is the situation envisaged by Sir David Rivett in the paragraph cited above, and is one which has been found to apply to the American cotton crop.

The Australian output of some other primary products—dried fruits, butter, etc.—was restricted, legally or otherwise, before the war, because it was believed that the available market was inelastic, and that the attempt to market increased quantities would lead to a disproportionate fall in price. It is unnecessary to stress, in this connection, that the available market, particularly for perishable products, may represent only a small part of the total world market.

It may be seriously questioned whether research, designed to increase production by reducing unit costs, is justified in the case of commodities such as those mentioned above. Such research, if successful, would be likely to lead to the adverse effects on equality of incomes discussed in the previous section, with a consequent upsetting of the balance of the industry. On the other hand, there seems to be ample justification for research designed to overcome seasonal fluctuations, or to improve the lot of the marginal producer.

In contrast to these major export products may be mentioned those in which Australia is less than self-sufficient, or in which Australian production is only maintained by protection in the form of tariffs and bounties. Here any research which had the effect of reducing unit costs would appear to be wholly beneficial; out-

standingly so if it enabled Australia to produce competitively commodities for which her costs of production were previously above world levels. This applies, too, to products for which a rapidly expanding market is available, or for those in which the market is highly elastic.

Conclusion.

This discussion has but skimmed the surface of the problems, and no account at all has been taken of many secondary consequences of successful agricultural research. Yet it will have served its purpose if it has drawn attention to the fact that the "conflict between progress and security", to which so much attention is being given elsewhere, is not without relevance in a consideration of desirable directions of agricultural research. The decision on whether research should be undertaken on one line rather than another, or on the production of one commodity rather than that of another, is not one to be made by the agricultural scientist alone. He is best able to judge the possibilities of success of any particular investigation, but he must seek the co-operation of the economist in deciding whether such technical success will in fact serve the best interests of the agricultural community as a whole.

The post-war world will, almost certainly, be one of regulated economy, and it is vital that the different branches of that economy should be correlated and work towards the same ends. If we accept Professor Pigou's definitions of the aims of economic policy, these aims must be kept constantly in mind in all decisions involving long-term action. It is true, no doubt, that if the results of a particular line of agricultural research should conflict with one or other of these objectives, compensatory action could be taken in the economic field, but, at best, the necessity for such compensation would greatly reduce the value of the work.

The post-war world is, admittedly, still obscure, but it is not entirely dark. Forecasts have been made of probable changes in Australian primary production, and it is not too soon to enquire into the bearing of such changes on agricultural research. Shall we, for instance, concentrate on the problems of those branches of agriculture which appear likely to expand, or rather on the mitigation of the inevitable disruption in those which may contract? On the problems of marginal producers and marginal areas, or on those of more favoured districts? What measures are necessary to ensure that the benefits of research accrue to as many producers as possible?

On all these problems, a joint enquiry of economists and agricultural scientists would be of value, and would clarify the issues when detailed projects come up for consideration. In so doing, it would help to ensure that any long-term research project undertaken could be carried through to its conclusion, and not, as has happened in the past, be suspended because it appeared to have outlived its economic usefulness.

(Received for publication, 18th November, 1943.)

Agronomy

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The term "agronomy" has not long been employed in Australia, although it has been common enough in the United States since the beginning of the present century.

So much confusion has existed and appears still to exist in our own country as to the nature of agronomy and the field it can justifiably cover, that an attempt is made here to define the subject as a branch of scientific research in agriculture under Australian conditions.

Origin of the Term and its Early Meaning.

According to the Oxford Dictionary, agronomy connotes the management of land or rural economy, and its use in that sense has dated from 1814. It appears to have been derived from the Greek *agros*, a field, and *nomos*, management. *Nomos* signifies, in the original meaning, custom or law, leading to management in the case of a field. *Nomós* indicates a pasture or district. There is a Greek word *agronomos*, overseer of the public lands, and this is in line with the national responsibilities associated with agronomy, as interpreted, e.g. in the United States. Professor J. A. Prescott has made the following comment: "French usage of the term dates to the 14th century, when agronomists were defined as officers who manage any of the things outside the city in the fields. The term *nome* is an ancient one implying direction, law or management, and was given by the Greeks to an administrative unit in Egypt."

Little technical significance formerly has been attached to the term in England, but in America it has become a major subject of research and teaching in agriculture. The title of agronomist was first applied to technical workers in the United States in 1900, when three of the staff of the University of Illinois were so designated.⁽¹⁰⁾ In 1902, detailed descriptions of courses in agronomy at the agricultural colleges of Alabama, Illinois, Michigan, Minnesota, Nebraska and Ohio, and of the agricultural institute of the University of Göttingen, Germany, were made available in the United States.⁽⁸⁾

The foundation of the American Society of Agronomy in 1907 led to a vigorous development of the subject as a field science, and this was attended by an equally rapid growth of agronomic personnel.

From the outset, agronomy dealt with the inter-relations between soils and crops. Much work had been carried out previously on these problems in Europe, and to a lesser degree in America; but up to that stage greatest stress appears to have been placed on the soil, as it affected plant growth. The move to establish agronomy as a cognate science was the outcome of a shift in emphasis towards the plant, in its relation to the many factors of soils, climate and management which influenced its growth and development.

It has always been considered that agronomy is an applied science and that the agronomist is required to fulfil a practical function. The development of agronomy has proceeded on an essentially quantitative basis, however, and agronomy has been responsible for material contributions to biology generally. According to Harris,⁽³⁾ workers in the so-called "pure sciences" have tended to consider that while they are engaged on problems germane to science, the agronomist merely applies scientific knowledge to the practical problems of agriculture. The task of applying principle to practice is in itself a scientific problem, he asserts, and research in

agronomy is capable of advancing knowledge in more specialized fields. With this it is not difficult to agree.

Development in the United States.

It might be stated that agronomy first developed as a typically American urge to grow "bigger and better crops"⁽²⁾. While the subject proceeded through its initial stages at a time when emphasis was placed on the increase of production *per se*, attention invariably has been devoted to the maintenance and improvement of soil resources.

The earliest activities of American agronomy were those concerned with the testing of varieties, the breeding of improved plant types and cultural, rotation and fertilizer tests with the more important farm crops.⁽⁶⁾

Although incalculable labour was expended in the collection of taxonomic and experimental data, much of the work tended to be empirical, and this was encouraged by the fact that the earlier tests were conducted in an era of description and classification in scientific work generally.

During the past twenty years agronomy in America has entered a new phase in which its basis has become ecological and physiological. Stress has been placed more and more on the relation between organism and environment; and in coming to see the numerous facets and their interplay in the integrated whole which represents his true agronomic problem, the agronomist finds himself at a cross-roads⁽²⁾ or meeting place of several or many specialized sciences. He can then, if he wishes, choose one of three courses: (a) retain a broad generalized, scientifically superficial but none the less useful knowledge of his problems; (b) become specialized in and restricted to a narrowed aspect of the field; (c) attempt to combine breadth with advanced research in a selected field of science, which is not easy.

Since about 1935, when far-reaching legislation was passed to promote soil conservation, agronomy in the United States has become directed more and more to soil-building problems; and this has resulted in a newly-awakened interest in pasture work.

By convention, the agronomist has generally been associated with the word "crop". Apart from natural grazings, or "range" country, the farm animal in America depends primarily on the "forage crop", grown for hand-feeding, and on grains and other concentrates. This is due to the long periods in winter during which growth is impossible and stock require to be housed, the cultivable nature and natural fertility of the soils in most higher rainfall areas, and a rapid crop-like growth in summer, resulting from a combination of favourable temperatures, long days and liberal summer rainfall.

For this reason perhaps cultivated pastures for permanent grazing have been relatively rare and the term "agrostologist" has been little employed except in relation to the taxonomy of the Gramineae, wherein it has its original accepted meaning. In Australia we have used the term "agrostology" and "agronomy" to cover the same type of work in what is essentially pasture ecology, and with a certain amount of confusion to a great many people, to whom each term has been rather foreign.

With the increasing interest of American agronomists in pasture work it is not likely that they will style themselves agrostologists, but rather become pasture agronomists.

Agronomy in Great Britain.

Although much that could be termed agronomy has proceeded in Great Britain, the term has as yet been little employed in that country. Scientific work in agriculture prior to the present war appeared to proceed along narrow channels, with relatively poor integration, restricted co-operation among workers and limited

application of much scientific work to the practical problem. This did not apply to all centres of investigation, and it is certain that marked changes have occurred in Britain during the course of the war. The work at Aberystwyth has freely been termed agronomic by its late Director; at Oxford the term rural economy is used; at Cambridge and most other British centres the traditional and all-embracing term "agriculture" has been retained. At Rothamsted, recent advances of importance to agronomy have been made in statistics and field experimental technique on the one hand, and in plant physiology on the other. At this centre, however, the term agronomist has rarely been employed.

Some thought-provoking views regarding the nature of agronomy have been expressed by Stapledon,⁽⁵⁾ who has given it as his opinion that no problems demand such "prolonged and large-scale agronomical investigation" as those of grassland.

Stapledon points out that research in agronomy is primarily research in the field, and that its major aim should be "to study all the factors which are operative at once and together, and in their natural interplay". He draws a distinction, however, between agronomic research and scientific research, the latter qualified it is true in the terms "as normally understood and conducted". With this distinction one cannot agree. Agronomy, as it is being developed in Australia, is essentially scientific, both in approach and in method; its existence depends, as that of the Royal Society of England was once stated to depend, on the acceptance of the view that knowledge is to be gained by experiment.

What Stapledon deplors, in his separation of agronomical research from "scientific research as normally understood and conducted", is the glorification of statistical methods for their own sake, which, he states, has tended "to obscure the wood for the trees, to concentrate on the part (yield, for example) instead of the whole". He avers that "the technique of agronomical research entails a great deal more than blindly following all the elaborate rules and regulations laid down by the statisticians", that in his capacity as an agronomist he has been responsible for the setting up of hundreds of weird little field experiments involving in all literally thousands of plots, naturally to answer thousands of inter-related questions. In this there is much wisdom.

Stapledon concludes "that the greatest and final hope (for agricultural betterment) is the farmer himself, for he is at least untrammelled by the technique of science and is not a slave to the fashions current in science, while his major training is not in collecting data, but in the gentle art of unadulterated observation".

With Stapledon's views one may or may not agree, but at least they are stimulating. Progress in grassland work owes much to these thousands of weird little experiments; yet it also owes much, and is likely to owe more to statistics, which Stapledon so obviously distrusts, but which for all he says, must be the major tool or weapon, if not the basis, of sound agronomic research.

Principles of Modern Agronomy.

Let us take Stapledon's views and his warnings and attempt to mould them into a logical and essentially scientific approach. It seems that we must arrive from this to the five essential steps of accepted scientific method, as outlined by Brierley,⁽¹⁾ namely:

- (1) Observation.
- (2) Perception of relationship.
- (3) Inductive reasoning leading to a provisional working hypothesis.
- (4) Experimental testing of hypothesis.
- (5) Elevation of the confirmed hypothesis to principles of generality.

The farmer, in whom Stapledon places such store, and to whom we all look, with justification, for guidance, is well able to pursue the first three steps, which it is the right of anybody else, after all, to traverse; and he may also by confirming in

practice and extending to general use the knowledge established by experiment so much to implement the fifth. But it is in the fourth, namely the experimental testing of hypotheses, that the agronomist finds his greatest scope.

We need to stress a number of facts which relate to the application of the method outlined above.

The agronomist is faced primarily with a practical problem to which economic considerations are usually attached.

The investigation of this problem in the field, where there is an uncontrollable setting, may be more difficult than in the laboratory or the glasshouse.

The investigation does not seek only to apply scientific knowledge to the practical problem, but seeks also to establish new knowledge.

While observation and experiment are both indispensable, their importance is outweighed by original and creative thought.

The results of scientific work can be expressed readily and should be expressed in language intelligible to the farmer or the layman. Agronomists do not find this difficult, owing to their everyday contacts with agricultural practice; but because of this very fact, the work of the agronomist has sometimes been regarded as unscientific. In my own view, agronomy should aim at the highest level of intellectual attainment possible, but as Brierley⁽¹⁾ has pointed out, we are not pure intellects but men and women in a work-a-day world, with all its human contacts.

Ecology, Statistics and Physiology.

An understanding of ecology is basic to agronomy, because our agricultural problem is invariably the question of the relationship between an organism and its environment. The organism may be plant or animal, the improvement of which is a matter of selection and breeding; or it may be a plant-animal complex, as in the case of the pasture in its relation to animal production; or it may be the human community as governed by climate and soil, food supply, æsthetic value of surroundings and various sociological considerations. Whatever our problem, we can separate our organism on the one hand from its environmental complex on the other.

It follows that a knowledge of climatology, soils and biology is essential; but the necessity for quantitative evaluation places statistics also as an indispensable tool, and like any highly specialized and complicated piece of machinery, statistics requires to be understood and experienced in practice before one can hope to make effective use of it. But it is equally important that the purpose for which the tool is being used is as thoroughly appreciated. I have known specialized workers to approach the statistician for assistance in a climatological problem, of which neither could possibly see the real implications. If the agronomist were consulted, in eclectic matters of this kind, both orientation and objective could in many cases be more clearly defined, and the statistician better able to suggest a suitable method for the real problem.

One should not place statistics as the first scientific need of agronomy, because that is unquestionably ecology in its most fundamental sense. But once ecological approach and experience have been gained, statistics becomes indispensable to the measurement of the factors whose significance has become recognized, and as previously pointed out,⁽⁹⁾ the key to our approach is *via* R. A. Fisher's Analysis of Variance, which enables the variance as it occurs in the field to be measured and accepted as a whole, but partitioned for rigorous sub-measurement, into its component parts and their interactions.

The mutual inter-relations and inter-dependence of agronomy and plant physiology have been much stressed in America; and it has been pointed out that physiology was born in an agricultural academy.⁽⁴⁾ Hottes maintains that plant

physiology continued to prosper for a time after it had been divorced from its early associations, but retrogressed as intensive studies of specific functions unrelated to the natural phenomena of the field were pursued.

The degree and ease of control to be obtained in pot cultures and the laboratory have encouraged the plant physiologist to disregard the ecological complex to which his specific problem is related; the agronomist can help to ensure that investigations of physiological function retain a sufficient bearing on major field problems.

A high level of plant physiological understanding appears to be the general rule among workers in agronomy in the United States. The trend away from routine tests of variety and crop management to investigations of climatological and nutritional factors in relation to plant growth and composition has made this inevitable.

Co-ordination and Specialization.

It has already been pointed out that agronomy stands at a cross-roads of the specialized sciences which relate to agriculture. Agronomists, therefore, by concentrating on a particular aspect of an agronomic problem, may enter such fields as those of climatology, soil chemistry or physics, microbiology, physiology, plant biochemistry, statistics, genetics, taxonomy, economics, etc. It is held in the United States that the greatest advances in knowledge have been made through increased specialization⁽²⁾; but care is taken to preserve balance by means of organized co-operation.

This has been achieved in America by fostering successfully unselfishness and the give and take principle; which in that country rarely means "you give and I take". Unfortunately in Australia there has in the past been much of this latter form of exchange, and there are some workers who seem constantly to be governed by a fear that their very thoughts will be taken from them and mercilessly exploited.

Just as an agronomist may become highly specialized in a single narrow field, so may a specialized worker by broadening his interests enter the field of general agronomy. The latter is the much more difficult course, however, and is impossible unless considerable practical experience and awareness of agriculture and an ecological outlook have been gained. In all work that seeks to be carried out under the guise of agricultural science, it seems that there is a moral responsibility on the part of the investigator to maintain one eye at least on the practical problem. Otherwise he might just as well leave the realm of agriculture and openly follow the course to which he is intellectually wedded.

Whatever the degree of specialization followed, there will always remain in agricultural research generally, and in agronomic work in particular, the necessity for planned co-operation, and the success attained in this direction largely depends on factors of personnel.

Professional jealousy and institutional pride have long been marked as the main bugbears of co-operative effort. While active antagonism can hardly be termed rife in Australia, there has been much self-centred indifference and some tendency to follow a personal bias or to secure personal advantage to the detriment of general progress. There is room for a greater acceptance of the right of all workers to enter any field in which they are likely to help, and a realization that helpfulness or sacrifice on the part of the individual scientist must react to the benefit of that individual also.

The conclusion may be drawn, then, that co-ordinated work is necessary in agronomy. While detailed understanding can only be secured by advanced specialized investigation, it is still equally true that the intricate complex of factors common to most agricultural problems requires efficient teamwork.

An Australian View.

The following is the writer's viewpoint of the subject, as it is tending to be developed in Australia.

Agronomy is essentially a field science and endeavours to assess the problems of field husbandry, whether of crop, grassland, or both combined, in relation to ecological factors and physiological principles. It seeks to analyse the agricultural problem in terms of the many interacting factors of soil, climate and biology, including management, and to understand the role of limiting factors in their relation to the field complex.

It is thus broad, generalized, wide in scope, and should serve as a meeting place for more specialized sciences. Much of its ambit is co-ordinative.

Workers in agronomy should possess an advanced knowledge of ecological and physiological principle, a sound training in statistical approach and method, a knowledge of climatology, soils and economics, and a practical awareness developed from extended experience of agricultural field problems and efficient farm management. They should be capable of assessing the relative importance and significance of more specialized branches of science in relation to their own problems.

Agronomy, while assisted greatly by field observation and depending a good deal on constructive and creative thought, is required at all times to be accurately quantitative, and like any other branch of science, is based on tested, verifiable and organized knowledge. Its application reveals how much scientific progress has outstripped its social utilization, and the extent to which human activities have failed to keep pace with our widening capacity for control over nature.

Agronomists may find it necessary to augment their field work by special glasshouse or laboratory investigation; but they have learnt not to generalize from the results of researches carried out in the pot culture house or laboratory, and to rely finally on the results of their own experiments, carried out in the field.⁽³⁾ The agronomist naturally therefore appeals to the method of plot testing. It is essential that his field experiments should be wisely planned, accurately executed and sensibly interpreted; and a sound working knowledge of statistics is as indispensable in the planning of the work as in its analysis and interpretation.

Agronomy and Reconstruction.

This brief review is concluded by a comment on the rôle agronomy might occupy in future agricultural adjustment and reconstruction in Australia.

The work of the Soils Division of the Council for Scientific and Industrial Research since 1930 has emphasized the soil survey as a primary basis for future agricultural use; and ecological analysis of the natural vegetation associated with each soil type has proved specially informative. The land use survey must nearly always be of limited value, however, because it can only be based on what practical experience has arrived at by trial and error. It cannot point to new methods or principles, many of which only technical investigation can reveal, and on which future progress may depend.

It is obvious that the logical outcome of the soil survey is agronomic experimentation designed to determine the most effective land use or uses to which each main soil type could be put. This has occurred on a number of surveyed types in South Australia, on each of which agronomic investigation has provided factual evidence which has served as a guide to future agricultural use. Where agronomic work has not been preceded by a soil survey it is of considerably less value.

As long ago as 1915, C. E. Thorne,⁽⁷⁾ in a presidential address to the American Society of Agronomy, stated that "by the soil survey we may classify our soils on the basis of their geological history and physical characters, and thus may be enabled

to limit the far more difficult and costly field experiment to general soil types, but unless the survey is followed and its findings interpreted by field experiment, it will have very little value. We may learn much by chemical analysis and by pot-cultural work, but the final answer to our questions can be obtained only in the field."

Whether State or Federal services foster agronomy in the future there is much room for an enlargement of competent and adequately trained personnel for work in this field, and it is also desirable that there should be a minimum of political interference with personnel and with policies.

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(Received for publication, 18th November, 1943.)

Planning for Soldier Settlement on Irrigation Areas in Post-War Years

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When the war is over our servicemen will desire to return to civilian life as speedily as possible, but in not a few cases their thoughts will be accompanied by misgivings as to the future. Many will return to their old posts, but some will not be so fortunately placed, and their future may depend to a large extent on the care with which repatriation schemes are prepared.

Land settlement should have a place in any repatriation plans, not only to meet the wishes of prospective soldier settlers, but also because rural development is so closely linked with the future progress and welfare of this country. Experience has shown that there are many difficulties to surmount before any land-settlement scheme becomes successful. It is most appropriate, therefore, that the problems associated with the settling of ex-servicemen on the land should be discussed and thoroughly understood by members of the Institute of Agricultural Science, because agricultural science must play a vital part in the planning, initiation, development and progress of any land settlement projected. The subject of soldier settlement covers a wide field but, as the writer has been closely associated with the River Murray Irrigation Areas, it is proposed to deal with the subject particularly in relation to irrigation settlement.

Repatriation.

In approaching the subject of soldier settlement, there should be a clear conception of what is understood by "repatriation" as applied to land settlement.

During, and immediately following, the 1914-18 war, many extravagant repatriation promises were made. Some of these promises were unfair and misleading, and over the years they led to disillusionment and disappointment for many settlers and to serious difficulties for the administration. It is expected that repatriation after this war will cover a much wider field than hitherto; doubtless it will embrace trades and professions as well as land settlement. Those trained for the trades and professions naturally will receive the remuneration prescribed for their callings, but that would be difficult to arrange in the case of settlers on the land. It must be prescribed, however, that settlers do not get less than a reasonable remuneration for their labours. On the other hand they should not be led to believe that they will get rich quickly, and at a comparatively early age in life be able to sell out at a handsome profit and live in ease for the rest of their lives. The aim should be to see that all soldier settlers are assured of sufficient financial assistance to enable them to be properly established on the property, and that their future should offer not only a reasonable livelihood but, subject to the proper performance of their duties, security of tenure.

Success or Failure Depends on Markets.

The question of markets, which is fundamental to any land settlement scheme and on which will depend its success or failure, does not appear to have received due consideration in planning for the expansion of primary production after the 1914-1918 war. This resulted in serious difficulties in the sale of produce, and, in so far as the dried fruits industry was concerned, might well have proved more disastrous than was the case had it not been for the voluntary marketing scheme which had already been developed by the growers.

The need for organized marketing in the dried fruits industry became apparent first in 1895, when as a result of competitive selling among themselves, growers received only 1½d. per lb. for their raisins and incurred a loss of many thousands of pounds. This resulted in 1896 in the formation of the Mildura and Renmark Raisin Trusts. In 1904 the Australian Dried Fruits Association came into being. This Association determined not only the price but the terms and conditions of sale to agents, distributors and retailers. In this way a measure of prosperity was assured to the grower. By 1911 a surplus of currants and sultanas was being produced and the problem of exporting at prices lower than those ruling in Australia had to be faced. This was a testing time for the Association, which, having no statutory powers, had to rely solely on the loyalty of its members. By 1913 disloyal elements, or "the outsiders" as they were termed, were making their presence felt by selling the whole of their crops on the best market, leaving the less remunerative channels to the members of the A.D.F.A. In 1913 "outsiders" sold their fruit in Australia, but during 1914-18 they were attracted by overseas returns. This unfair arrangement continued until legislative action was taken to ensure an equal share for growers in all markets.

An understanding of the problems facing the industry will be gained when it is realized that production of dried vine fruits increased from 19,000 tons in 1922 (with an export of 5,000 tons) to 53,000 tons in 1927 (export 40,000 tons). Production continued to increase until a maximum of 95,572 tons was reached in 1940 (export 77,327 tons). Total production that year, including dried tree fruits, was 100,240 tons. This rapid expansion, without due regard to markets and notwithstanding the voluntary efforts of the growers to meet the situation, resulted in considerable financial loss to the Commonwealth and State Governments, and disappointment to the soldier settlers, who had anticipated the maintenance of the high prices ruling both during and immediately following the war. Details of the prices paid to growers by one of the leading co-operative companies for the years 1920 to 1942 for sultanas, currants and lexiass are shown in Figure 1.

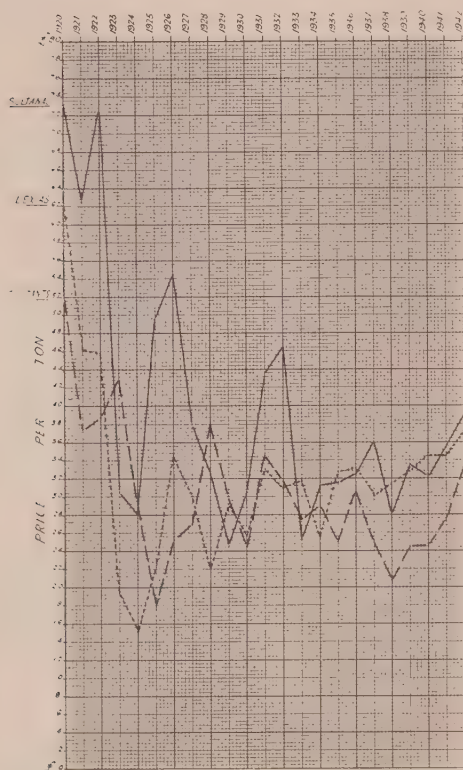


Figure 1.
Prices for Sultanas, Lexias and Currants paid
to growers by a leading co-operative company,
South Australia, 1920 to 1942.

The measure of prosperity enjoyed by the dried fruits industry during the past few years affords the best possible example of the benefits and importance of orderly marketing and encourages the belief that it could, with advantage, be extended to other forms of primary production which might come within the scope of future soldier settlement.

A factor that cannot be overlooked in considering market prospects is that the terms of the Atlantic Charter of 1941 foreshadow the review of preferences, for in that Charter it is declared that it is "designed to eliminate all forms of discriminatory treatment in international commerce, and the reduction of tariffs and other trade barriers".

Briefly, the problem that confronts the Government is to decide whether it should hold over the expansion of primary industries until markets are assured, or whether it should foster the extension of those forms of production which appear to offer the greatest promise of satisfactory development. Should the latter alternative be approved, the Government must then accept the further responsibility of creating a marketing pool and guaranteeing producers their cost of production until such time as the requisite markets have been established.

Factors Affecting the Planning of Settlement Schemes.

Suitability of Soil and Climate.

Suitability of soil and climate must not be overlooked in planning any settlement scheme. The establishment of the Soils Division of the C.S.I.R. has placed at the disposal of the Government a competent organization to undertake the examination of soils. Irrigation authorities place the highest value on the C.S.I.R. soil maps. They have proved invaluable in dealing with many of the problems associated with the administration of settled areas, and are used as a guide in any replanting or expansion programmes undertaken. The only regret is that these maps were not available before existing areas were developed. Soil surveys would have a special value in determining future plantings, and could be used with advantage as a guide by rent fixing and valuing authorities.

Climatic conditions must be taken into consideration, particularly where fruit production is concerned. Excessive and frequent frosts are in some districts the fruit-growers' worst enemy, and as yet it has not been possible effectively to combat

them except over a limited area. When the drying of fruit has to be undertaken, drying conditions are of considerable importance, not only from the financial aspect, but also from the point of view of quality. A careful study of climatic records in any area selected for possible development should therefore be made.

Developmental Costs.

In any projected irrigation scheme the cost of developmental work, such as the provision of pumping plants, the construction of main channels and other essential headworks, must be carefully estimated, as these estimates would indicate whether the scheme could be developed for an outlay of capital commensurate with its importance and ultimate value.

The return of full interest on expenditure, whilst of some importance, should not it is suggested be the sole determining factor. Any probable loss should be offset by the advantages which might accrue to the country, and which might be gauged by considering the value of the established River Murray irrigation settlements.

Before the development of certain areas in South Australia, 50,000 acres supported one or two families. Today settlements of 7,000 acres of plantings in the same district support a population of 3,500 or one person to every two acres—a truly striking example of the advantages, and importance of closer settlement under irrigation, to the welfare and progress of Australia.

Running and Maintenance Costs.

Running and maintenance, or annual costs, would include the cost of pumping, maintenance and replacement of machinery and plant, maintenance of headworks, and administration. Any scheme not offering reasonable prospect of settlers being able to meet these costs would have little to commend it. If interest on headworks could be recovered from settlers, this should be added to the annual charge.

Size of Holding.

The size of the holding must be sufficiently large to ensure adequate returns, taking into consideration soil types, and other factors likely to influence production. In view of the uncertainty of markets, it is better to have the holdings too large than too small, but the risk of going too far in this direction should be carefully watched.

Selection and Training of Settlers.

The personal element contributes vitally to the success or failure of any land settlement scheme, and this applies particularly to horticulture under irrigation. The essential qualifications are a capacity for work, sufficient interest and intelligence to acquire readily a full knowledge of all matters necessary for the efficient management of the property, and ability to apply the knowledge acquired. The first step should be the selection by an experienced board, through personal interview, of applicants for training. The Selection Board's enquiries should be most searching so that unsuitable men, and those suffering from physical, or other disabilities, can be eliminated.

The cheapest and best method of training would be to place approved applicants with carefully selected growers, for training for a minimum period of twelve months, so that experience might be gained in all seasonal work. Departmental instructors should be appointed to observe the practical training, and to arrange for demonstrations and lectures. Qualification certificates should be given to approved trainees. The grouping of trainees in schools was tried after the 1914-18 war with very disappointing results, and is not therefore favoured.

Allotment of Land and Control after Allotment.

Only persons holding qualification certificates should be entitled to apply for land, subject to discharged soldiers' conditions. The land should be held under permit for two years. The working and general conduct of a settler would be observed by departmental inspectors and/or instructors during this period, and attendance at official demonstrations and lectures would remain obligatory. The final stage of what might be termed the probationary period would be reached at the end of the second year of occupation, and perpetual leases could then be issued to settlers who had given evidence of their interest, industry and general suitability.

If at any time it were decided by the Minister, after due enquiry, that a settler was not likely to succeed, prompt action should be taken to terminate occupation so that he might engage in some other vocation before becoming too old. The policy of allowing such settlers to continue in the hope that they will improve can result only in financial loss to the Government and, eventually, in disappointment and hardship to the settler as, with advancing years, he would be less able to find other suitable employment.

Conditions of Allotment.

The only tenure provided for settlers within irrigation areas in South Australia is a perpetual lease. There could be no more suitable title for, while giving occupation to the settler in perpetuity, it does not alienate the land from the Crown. All transfers of leases should be subject to the approval of the Minister, and, in order to discourage speculation, restrictions should be placed on the sale of a property for, say, eight years. If, within that period, a settler is forced to surrender his land through no fault of his own, he should be paid by the Crown for his equity therein.

Development of Holdings.

The responsibility of developing the holding should, as far as possible, rest with the settler, as this would create greater interest therein, and would give him experience in performing tasks which might not have been covered during training on an established holding.

There is, however, certain work which could best be carried out by the responsible department with its specially trained staff, and with the necessary mechanical plant and equipment. This would include the following :

- (1) Installation of irrigation pipelines and construction of channels.
- (2) Clearing timber.
- (3) Grading the land.
- (4) Preparation of planting plans showing (a) planting angles, (b) soil types, (c) plantings suitable for soil and locality.

Financial Assistance and Administration.

It is most desirable for applicants to have some private capital to assist in meeting developmental costs and living expenses, but, under a repatriation scheme, lack of private capital should not prevent the ex-soldier from enjoying the privileges of soldier settlement any more than it should prevent him from taking advantage of repatriation conditions to learn a trade or complete his studies in a profession. Advances should be on a scale sufficiently generous to permit the carrying out of developmental work, the purchase of plant and the payment of a sustenance allowance during the unproductive period. Advances under the various headings should be limited to previously determined amounts and the settler should be required to work strictly within those limits. Advances should be closely supervised, and steps should be taken by the administration to ensure that the money is spent to the best advantage.

Notwithstanding careful planning and the practice of every economy, in certain projects settlers may not be able to repay the whole of the expenditure necessary to bring the land into full production. During the unproductive period, which would vary according to the use to which the land was put, debts would accrue for rent, water rates and interest. Such debts should be consolidated in one account.

When a stage of production is reached that would enable a settler to commence payments, his prospects should be carefully examined, and any debt in excess of what the property could be reasonably expected to carry should be written off. The settler would then be given a start free of arrears, and thereby encouraged to meet his future payments as they fell due. To leave settlers with debts they have no prospects of meeting would not be in the interests of either the Government or the settlers, and would not be fulfilling the aims of repatriation, namely to ensure reasonable returns and security to the settler in the future.

It is not possible in this article to deal in detail with the many points of administration involved in the development and administration of a soldier settlement scheme under irrigation but, in as much as the success of any soldier settlement scheme is largely determined by the efficiency of its administration, it is most essential that

- (1) The undertaking be practical and sound.
- (2) The Government clearly define the conditions under which it is to operate.
- (3) The administration entrusted with the task of carrying out the Government's declared policy be free of outside interference.
- (4) The administration be placed in the hands of practical and experienced men.

Unless this is done, there will be a repetition of the mistakes made in the early days of soldier settlement. The major errors of those days stand out like beacons for those to see who may be charged with the responsibility of directing any new schemes and, if those signs are disregarded and the scheme is wrecked, those responsible will have failed badly in their duty.

Conclusion.

There can be no question but that the Commonwealth and State Governments have benefited considerably from the establishment of the irrigation areas on the Murray River. Semi-arid lands supporting a very small population have been transformed into highly productive areas, and valuable business centres have been created. Closer settlement has been effected under ideal conditions. The problem of isolation, which has proved such a drawback to the development of broad areas, has been overcome; the thriving irrigation communities have provided themselves with all those amenities conducive to contentment and happiness.

The Murray Valley is a source of still greater potential wealth, and its development, which must be closely linked with our progress, should have an important place in any soldier settlement plans.

(Received for publication, 22nd October, 1943.)

TECHNICAL NOTES

EXPLORATORY INVESTIGATIONS OF SOIL DEFICIENCIES BY MEANS OF SMALL POT CULTURES.

The dependence of Australian agriculture on phosphatic fertilizers has long been recognized; and the increase of nitrogen status by the use of leguminous herbage plants has for some years been the accepted basis of soil improvement in the areas of highest winter rainfall. About the 1935-39 period, much land was cleared in the southern portions of South Australia for seeding to pastures based on sown legumes and grasses, with liberal dressings of superphosphate. Recent examination of these areas and of older seeded pastures in the same districts has indicated that production far below that possible in terms of the available rainfall has in most cases resulted; and a low level of availability of minerals other than phosphate has been increasingly considered as a possible reason for the poor growth of the herbage legumes.

So far as South Australia is concerned, deficiency of manganese has been recognized⁽⁴⁾ in the south-eastern district since 1927, but the application of this knowledge has been confined to cereal crops, and manganese has not been applied in practice to seeded pastures. Responses to copper were first obtained⁽²⁾ at Robe in 1937, and at the same centre a response to zinc was recorded⁽³⁾ in 1939. Citrus trees had been found to respond to this element earlier.⁽⁵⁾ Boron deficiency was established⁽⁶⁾ at McLaren Flat, South Australia, in 1939, and in 1941 applications of molybdenum produced greatly increased yields of subterranean clover⁽¹⁾ at Meadows, South Australia.

The frequent failures of seeded pasture in high rainfall districts, together with increasing evidence of response to the above five elements, suggested further work of an exploratory character to indicate the extent and distribution of soil deficiencies likely to affect the production of herbage legumes in South Australia.

Experimental.

Owing to the impossibility of conducting field experiments at a sufficient number of centres, it was decided early in 1942 to test the method of pot cultures as a preliminary means of investigating large numbers of soils simultaneously, under comparable conditions of technical control. While it has long been recognized that the conditions of pot cultures may be far removed from those of the field and that the results obtained therefrom must be interpreted with caution, this glasshouse method has been employed at the Waite Institute as an adjunct to field investigation since 1925, and has proved to be of considerable value.

The size of pot employed has gradually been reduced from 24 kg. capacity, through containers of 12 kg., 4 kg. and 2 kg. finally to the small cylindrical glazed jars of approximately 0.7 kg. capacity ($3\frac{1}{2}$ in. $\times$ $5\frac{1}{2}$ in.) used in the present series (see Figures 1 and 2).

Soil was taken to a depth of 4 inches from several portions of an area selected as being representative of a particular soil type and situation. This was brought to the Waite Institute in clean bags and the soil mixed by passing through a $\frac{1}{4}$ in. sieve that had been painted over with clear Dulux, and turned with a non-metal spade, prior to filling. The pots have been at all times watered with distilled water. Following trials at different moisture levels ranging from 40% to 90% of capacity, all pots have been maintained at 70%.

Subterranean clover has been employed as a test plant from March to September and Palestine strawberry clover has replaced the winter-growing species during the summer months. It has been found possible to conduct two or three sequential trials on the same soil during a single year, using information from one trial in designing the next.

A basal dressing of phosphate has been applied in all tests.

At first, series of 16 pots based on the eight combinations of nil, (Cu Zn), (K Mn B), (Mo Mg Fe V) in duplicate, together with two pots receiving wood ashes and two additional controls, totalling 20 pots in all, were employed. Following evidence of response to one or more of the above groups, subsequent tests have been used to separate the effects of single elements and their interactions.



Figure 1.

Representative group of pots showing differences due to mineral treatment.



Figure 2.

Pots containing Woodside soil showing response to molybdenum. Left to right: Rows 1, 3, 5 and 7 received no molybdenum; rows 2, 4, 6 and 8 received molybdenum, 2 oz. per acre. Additional treatments have also been applied.

An example of two tests with a *terra rossa* soil from Mt. Benson, S.A., is given in Table 1.

TABLE 1.
Mean Dry Weight of Subterranean Clover (grams per pot), Mt. Benson Soil.

First Test.									
	No Treat- ment.	(a) (Cu Zn)	(b) (K Mn B)	(c) (Mo Mg Fe V)	(ab) (Cu Zn) (K Mn B)	(ac) (Cu Zn) (Mo Mg Fe V)	(bc) (K Mn B) (Mo Mg Fe V)	(abc) (Cu Zn) (K Mn B) (Mo Mg Fe V)	Wood Ash.
Mean of two pots ..	3.19	5.13	3.75	3.42	6.73	5.56	3.43	7.26	4.64
Difference ..	—	1.94*	0.56*	0.23	3.54*	2.37*	0.24	4.07*	1.45*

* Increase above superphosphate only is significant at 1%.

Interactions: a × b significant at 1%; a × b × c significant at 5%.

Second Test.								
	No Treatment.	Cu	Zn	K	(Mn B)	Cu Zn	Cu K	Cu(Mn B)
Mean of two pots ..	1.25	1.74	1.86	1.40	1.52	2.00	1.85	1.56
	Zn K	Zn(Mn B)	K(Mn B)	Cu Zn K	Cu Zn(Mn B)	Cu K(Mn B)	Zn K(Mn B)	Cu Zn K(Mn B)
Mean of two pots ..	2.42	2.03	1.62	2.36	2.47	1.62	2.52	2.46
	Cu ₀	Cu ₁	Zn ₀	Zn ₁	K ₀	K ₁		
Mean of eight pots ..	1.82	2.01	1.57	2.26	1.80	2.03		
Difference ..	—	0.19†	—	0.69*	—	0.23*		

* Responses to Zn and K significant at 1%.

† Response to Cu significant at 5%.

No first or second order interactions are significant.

Approximately one hundred tests similar to the two shown in Table 1 have been conducted.

A summary of the responses so far obtained is given in Table 2.

So far, this work has been mainly of an exploratory character, but its value has already been proved in revealing the widespread nature of the problem. The main disadvantage of the method is that the soil available for exploitation by the roots of the plant is limited; but as the size of the plant is also reduced by the size of the pot this is not considered to be serious. Traces of copper in the distilled water employed render confirmation of absence of response to copper necessary. The plants are harvested approximately twelve weeks from seeding; differences usually appear within six to eight weeks of seeding.

In cases where pot culture tests and field experiments have been conducted on the same soil, the field work has with few exceptions tended to confirm the responses obtained in the pots. Where confirmation has not been obtained the field investigations have in all cases not progressed to a sufficiently advanced stage.

TABLE 2.

Responses to Wood Ash, Groups of Minerals and Single Mineral Elements applied to a Range of South Australian Soils, 1942-43.

	Mean Annual Rainfall, Inches.	pH	Wood Ash	Cu B	Zn Mo	K Mg	Mn Fe	V	Cu Zn	K Mn	B	Mo Mg	Fe V	Cu Zn	K Mn	B	Mo
<i>Sands and fine sands ;</i>																	
Wattle Range, S.E. (a)	28	5.7	*							*							
" " (b)	"	5.8	*							*							*
" " (c)	"	5.9	*							*							*
Meadows (a)	33	5.9	*										*				*
" (b)	"	5.9	*												†		*
Mt. Compass	32	6.2	*		*										*		*
Vanilla, E.P.	24	6.9											*				*
Naracoorte, S.E.	23	6.5											*				
Bangham's Scrub, S.E.	21	6.6	*						*	*				*			
Yalkuri	18	6.7											†				†
Mt. Gambier	30	-		*												†	
Lake Albert	17	6.8								*			*		*		
Wood's Well, S.E.	19	7.0		*											*	*	*
Tailen Bend	15	7.3							*	†				*	*	*	*
Mt. Benson, S.E.	25	7.4	*						*	*				†	*	*	*
Culburra, S.E.	18	7.6	*						*	†					*	*	*
<i>Loamy sands and sandy loams ;</i>																	
Waitpinga (a)	28	5.9	*		*												
" (b)	"	6.2	*		*												
" (c)	"	6.3	*							†							
Big Swamp, E.P. (a)	24	6.5	†						†					†			
" (b)	"	6.6															
<i>Loams, clay loams and clays ;</i>																	
Big Swamp, E.P. (c)	24	5.8	*							*						*	†
Waite Institute	24	5.9	*							*							
Woodside	30	6.4		*						*			†		†		*
Glenroy, S.E.	25	6.9							*					*	†		*
Coonawarra, S.E.	25	8.2	*						*	*					*		
Rendelsham, S.E.	29	8.3								*							
Naracoorte, S.E.	23	8.6							†								

* Increase significant at 1%.

† Increase significant at 5%.

The principal value of the method is in the rapid provision of a lead to subsequent field trial. The final answer to the problem must be sought in the field experiment, but it is considered that the pot culture method can be developed to study in detail specific questions arising from the field work.

Acknowledgment is made to the Division of Soils, C.S.I.R., for classification of the soil types and determination of the pH values.

H. M. FERRES.

H. C. TRUMBLE.

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(Received for publication, 18th November, 1943.)

The Australian Institute of Agricultural Science

SIXTH GENERAL MEETING.

The sixth general meeting of the Institute was held at the School of Agriculture, the University of Melbourne, on 20th October, 1943, at 7.30 p.m.

The report of the Council, which is given on the following pages, was read by the Honorary Secretary. During the reading, at the request of the President, those present stood in silence as a tribute to the memory of those members whose deaths were recorded in the report, viz. Lt. P. R. Gorrie and Mr. L. J. Wilson. In moving that the report be received, the President expressed the thanks of the Institute to office-bearers for services rendered by them, mentioning in particular the Editor of the Journal, the Honorary General Secretary and the members of the Proxy Council.

The statement of accounts, which was published on page 134 of the September issue of the Journal, was adopted.

The Hon. General Secretary reported that the Council had re-elected Professor G. A. Currie as President of the Institute for the ensuing period. The President gave an address, entitled "Post-War Land Settlement, with Special Reference to Western Australia", which was followed by an animated discussion.

Report of Council to the Sixth General Meeting.

While officially this report covers the period to 31st December, 1942, the date of this general meeting requires that comment be made also on Institute activities during the months of 1943 which have already passed.

During the period under review the importance of food production to the war effort of Australia emerged in true perspective. As a result many members of the Institute are making greater direct contributions to the war effort than were possible previously. For many too, during the period, new responsibilities have arisen and changes in location and type of employment have occurred in many cases. Just as the responsibilities and activities of the members have increased, so also have those of the Institute as a whole. At the many points where Institute activities touch the war effort, it is the hope of your Council that real contributions have been made.

Membership.—At 31st December, 1942, the membership of the Institute was 473 Corporate members and 12 Student members, the respective Branch totals being as follows:

		N.S.W.	Vic.	S.A.	Qld.	W.A.	A.C.T.	Tas.	Total.
Corporate		131	121	58	57	57	32	17	473
Student		3	—	2	—	7	—	—	12

After allowing for resignations, deaths and cancellations of membership, the net increase in the number of Corporate members for 1942 was 10. During 1943, to date, 22 Corporate members and 3 Student members have been admitted.

According to present information, the number of members of the Institute who have enlisted for service abroad or at full-time defence duties in Australia is 53.

Your Council records with regret the following casualties among members on active service: Lt. P. R. Gorrie (W.A.), Killed in Action; J. O. Smith (N.S.W.), Missing; G. W. Clarke (N.S.W.), Missing; J. D. Bull (N.S.W.), Prisoner-of-War.

Lt. A. J. Schindler (Q.) has been awarded the Military Cross for Gallantry and Devotion to Duty at Milne Bay.

The death is also recorded with regret of Mr. L. J. Wilson, B.Sc.Agr., Analyst of the New South Wales Department of Agriculture.

Branch Activities.—As permitted by the circumstances of the times, Branch activities have continued in a satisfactory way. Of recent months an important activity of several of the Branches has been the preparation of material for presentation to the Rural Reconstruction Commission. Arrangements for the circulation of minutes of Branch Committee and general meetings has continued quite satisfactorily, and has been most helpful in informing the various Branches and members of Council of the views held by the respective sections of the Institute.

Journal.—The Publications Committee was reappointed at the beginning of 1943, with Dr. F. T. Bowman as Editor and Dr. N. S. Noble as Business Manager. As from Vol. 9, No. 1, March, 1943, the Journal has been published without advertisements, and your Council considers that the appearance of the Journal in this form is well worth the extra cost which is being incurred.

Qualifications Committee.—The members of the Qualifications Committee, Professor J. A. Prescott, Dr. A. R. Callaghan and Mr. Rowland Hill, were reappointed at the beginning of the year and have examined all applications for admission to membership. Favourable recommendations have been received from the Committee in regard to all applications submitted, though on more than one occasion a recommendation has been deferred pending further enquiries concerning a particular applicant.

Man-Power Arrangements.—The sub-committees provided by the Institute to assist the Man-Power Authorities in this work have continued to function throughout the year. Their advice has been of very great value to the Director of Scientific Personnel in dealing with men with scientific agricultural qualifications. Shortly these sub-committees will be examining the problem of the allocation of 1943 graduands to the many positions which are open to graduates in agricultural science. This question of first appointment is one of tremendous importance to the individual young men now entering the profession, and your Council considers that the Institute Committees are rendering most valuable service in this connection. In view of the shortage of trained personnel, which is likely to be accentuated post-war, recommendations have been made to the Man-Power Authorities that the quotas for entry of agricultural students into the Australian Universities for 1944 should be raised considerably. These recommendations are at present receiving consideration.

Rural Reconstruction.—Following the appointment of the Rural Reconstruction Commission by the Commonwealth Government, it was considered by your Council that it was the duty of the Institute to be of what assistance it could to the Commission. It was further considered that any Institute view on a particular subject should be submitted by a duly appointed spokesman. Five Branches of the Institute indicated their willingness to prepare material for submission to the Commission on this basis, and the evidence provided by three of them, South Australia, Victoria and Queensland, has already been presented. The two former reports dealt with the general question of agricultural education in those States and that of the Western Australian Branch will be on the same subject. The evidence presented by the Queensland Branch covered several important features of technical interest in connection with reconstruction in the northern State, while that in course of preparation by the New South Wales Branch will be a survey of technical efficiency in various branches of agriculture. The reception by the Commission of Institute evidence submitted to date has been most cordial and appreciative.

In addition to these official submissions, several members of the Institute have accepted the invitation of the Secretary to the Commission to submit personal evidence on matters in which they were particularly interested.

Agricultural Attachés.—Arising from a recommendation from the New South Wales Branch, action was taken to recommend to the Minister for External Affairs that Agricultural Attachés should be appointed to Australian Legations and Consular Offices abroad. A somewhat non-committal reply was received from the Minister, who, while sympathizing with the subject of the recommendation, considered that such appointments might be undesirable at the present time, owing to the difficulty the appointees would meet in regard to travel facilities in the countries in which they might be located. The Minister indicated that the proposal would be reconsidered at a later date. The matter is, however, being pursued further. Your Council has noted that Great Britain attaches such importance to these positions that for the appointment of Agricultural Attaché at Washington it has obtained the services for the duration of the war of no less a person than Professor J. A. Scott-Watson, Professor of Agriculture in the University of Oxford. The weakness of Australian agricultural representation abroad was fairly well indicated by the composition of the Australian delegation to the Allied Food Conference at Hot Springs, Virginia, earlier this year. This contained no agriculturalist of comparable standing to Professor Engledow and Professor Scott-Watson, who with two senior members of the staff of the British Ministry of Agriculture were members of the British delegation.

Soviet Scientists Anti-Fascist Committee.—In May of this year there was received by cable from Moscow an article for issue to the Australian Press, which had been sent by the Secretary of the Soviet Scientists Anti-Fascist Committee. This article took the form of an interview with the famous plant breeder Tzitsin concerning the success of the hybrids he had produced between wheat and Agropyron and the value of their perennial characters. After consultation with specialist plant breeders among members of the Institute, a statement was issued to 31 agricultural papers throughout Australia and was widely published. An acknowledgment of the cablegram together with cuttings from Australian newspapers was sent to the Russian Committee. More recently a further cablegram has been received. This concerns the tuberless planting of potatoes, and will be issued to the Press shortly.

Preparation of By-Laws.—Originating with a suggestion from the Queensland Branch, and after considerable discussion, it was decided by Council that By-laws should be prepared covering the various decisions of Council on matters of administration of the Institute. These By-laws are at present in course of preparation and will be issued shortly.

Liaison with Russian Scientists. Early in 1943 there was received from the Secretary, Australian Chemical Institute, information that it was the view of his Council that it would be to the advantage of Australia if contact between Australian and Russian scientists was established and that this might best be achieved by the appointment of a C.S.I.R. Liaison Officer to the Legation at Moscow. After consideration your Council decided to support the representations already made by the Australian Chemical Institute in this connection. Information has been received from the Secretary, C.S.I.R., that negotiations in connection with such an appointment are at present proceeding.

Centenary of Rothamsted.—The centenary celebrations of the Rothamsted Experimental Station took place on 21st July, 1943. On behalf of the Institute the following cable was sent: "Centenary greeting to World renowned Rothamsted from Australian Agricultural Scientists. May its future be brilliant as its past. (Sgd.) Currie, President, Australian Institute of Agricultural Science."

In reply to this cable a most appreciative and cordial letter has been received from Sir John Russell.

Conclusion.—At the meeting of Council on 30th November last, some consideration was given to a brief restatement of the aims and objects of the Institute as a guide to administrative policy. It was felt by those present that the following words were appropriate, namely "the primary object of the Institute is the welfare of its members that they might the better serve the agricultural industries of Australia and the community as a whole". During the period under review numerous opportunities of giving effect to this object have occurred, and have been accepted. Membership of this one Australian organization has meant something in promoting good-will among representatives of different organizations at important conferences, in helping in many instances to find the right man for the new job, and in making the stranger feel at home in new surroundings. Your Council desires to express its sincere appreciation to office-bearers, members of Committees and individual members who have done so much for the Institute in this way during the past year.

G. A. CURRIE,
President.

MEETING OF COUNCIL.

A Council meeting was held at the School of Agriculture, Melbourne University, on 13th September. The following applicants were admitted to corporate membership, following the receipt of favourable reports from the Qualifications Committee:—to New South Wales Branch: Miss H. M. Wrigley, Messrs. G. McGillivray, L. E. Rippon, G. J. Shanahan, A. H. Friend, K. O. Campbell, K. R. Green, B. O. French; to Victorian Branch: Messrs. G. C. Wade, M. Rothberg; to Western Australian Branch: Miss S. I. Rowley; to South Australian Branch: J. A. Seekamp. Miss J. C. Parker and Messrs. G. T. Halpin and R. H. Morris were admitted as student members. The financial statement showed a balance at bank of £130 4s. 0d.

MEETINGS OF BRANCHES.

Australian Capital Territory Branch.

At a well-attended meeting of the Branch, held on 25th August, Mr. J. G. Crawford, of the Ministry of Post-war Reconstruction, gave an interesting address on "Some Problems of Post-war Rural Reconstruction". The speaker reviewed the Australian economic position as it was in 1939, the changes brought about during the war, and the anticipated position in the post-war period. In the pre-war period, there was generally no difficulty in disposing of surplus commodities. Costs had declined at a much lower rate than prices, with the general result that rural indebtedness had risen steeply. An interesting incidental fact was that in few other countries was a lower proportion of bread-winners engaged in agriculture. The war period has been characterized by increased control of all aspects of agriculture, including both costs and prices. The return of 100,000 servicemen to rural industry will be one of the immediate post-war problems. Whether or not they decide to continue in such work will be influenced to some extent by the rural amenities provided or in prospect. Among the factors which will determine the economic health of our rural industries will be the extent of employment in Europe and America, the degree to which nutritional standards can be raised, both here and overseas, and the extent to which world and local prices can be stabilized.

New South Wales Branch.

A general meeting of the N.S.W. Branch was held at Science House, Sydney, on Friday, 5th November, jointly with the N.S.W. Division of the Australian Veterinary Association. Attendance totalling nearly 100 included representatives of all sections of the wool industry, producers, buyers, manufacturers and dyers.

The subject of the meeting was a symposium, "The Future of Wool", in which the principal speakers were Professor Ian Clunies Ross, Dean of the Faculty of Veterinary Science, University of Sydney, and Mr. A. R. Penfold, Deputy Director of the Scientific Liaison Bureau (N.S.W.) and Curator of the Technological Museum. These addresses appear elsewhere in this issue of the Journal. Vigorous general discussion was concluded on the following resolution being carried unanimously: "That this meeting, recognizing the grave problems which will face the sheep and wool industry in the post-war period, urges both Commonwealth and State Governments to expand greatly the resources available to the industry for scientific and technological research, and in co-operation with wool growers' associations to establish an adequate organization for international publicity for wool and its uses."

Queensland Branch.

Captain Norton, of the U.S. Army Quartermasters' Subsistence Depôt, delivered an address to the Queensland Branch on the subject of "Handling of Horticultural Crops for Processing". The speaker outlined first the processing programme of the United Nations, and dealt with the development of canning, freezing and dehydration of foodstuffs in the U.S.A. A description was then given of the functions of the field departments of leading processing firms. These include selection of acreages, securing seed, supervision of fertilizing, control of plant diseases and pests, determining time of harvest, selection of harvesting equipment, and supervision of harvesting methods. During the off-season the field officer concerns himself with treatment of seeds, seed selection, greenhouse work in development of varieties and selection of varieties for testing, and the collation of published technical information.

The pea crop was selected to illustrate requirements for the production of a high quality canning product. Peas are usually planted on a rich loam and are fertilized by side placement. It is necessary that the variety should mature uniformly in order to permit of mass production. The chief disease is root-rot, and a high degree of varietal resistance to this is required. Variety selection for nutritive value is, on the other hand, of questionable value. Pea moth, pea aphid, and pea weevil are important pests. Weeds, such as small thistle, which contaminate the harvested peas, are troublesome.

Harvesting is usually by a mower with a winnowing device. The viners follow the mowers to the field and harvesting is so arranged that the peas are delivered to the cannery within a few hours. They are transported in sterilized containers and sometimes packed in ice. In most cases payment is on the basis of grade, and classifiers test the consignments for insect infestation, toughness and other qualities. The influence of pH values of various crops on the processing treatment was also described.

South Australian Branch.

On Friday, 24th September, "Planning for Soldier Settlement in Post-War Years" was discussed at a general meeting of the branch. The discussion was led by Messrs. A. C. Gordon and R. Hill. Mr. Gordon discussed settlement in irrigation areas and Mr. Hill dealt with settlement in non-irrigated areas. Mr. Gordon's contribution is published elsewhere in this issue.

Tasmanian Branch.

Owing to the limited number of members and the fact that many of them are now decentralized, difficulty has been experienced in carrying on regular meetings. The following officers were elected at the meeting held on the 6th September: President, F. W. Hicks; Vice-President, F. E. Ward; Secretary-Treasurer, N. H. White; Sub-Editor, T. D. Raphael; Auditor, J. T. Gemmell; Committee Members, F. W. Johnstone and H. V. Rees. The greater part of the meeting was taken up with discussions on general Branch business. Regret was expressed at the resignation of Dr. J. W. Evans, who is leaving the State early next year.

Victorian Branch.

At a branch meeting on 3rd September, the speaker was Mr. H. C. Valentine, Chief Valuer, State Rivers and Water Supply Commission of Victoria, his subject being "Problems of Land Valuation". Mr. Valentine drew attention to the anomalous position existing in Victoria, whereby the same parcel of land could bear a different valuation according to the purpose for which it was valued, viz. Federal and State land tax, water supply and municipal ratings, selling and mortgage values, and land compensation. Particular reference was made to the Water Commission's obligations and experiences under the Victorian Water Acts, while examples of land compensation cases and their attendant problems were given. It was shown that in the majority of cases compensation was closely linked with some agricultural practice. The speaker suggested that a degree in agricultural science or a diploma from an agricultural college would be a tremendous asset to a valuer, and urged that there should be established in Victoria a central valuing authority similar to those operating in New South Wales, Western Australia, New Zealand and Denmark. The subsequent discussion was both interesting and provocative.

On 25th August, members attended a meeting of the Melbourne University Agricultural Society, at which Dr. I. A. Watson, of Sydney University, spoke on "Breeding for Rust Resistance in Wheat".

Breeding for stem rust resistance in wheat is being carried out at a number of institutions in Australia. It has been found that physiologic races of the stem rust organism can be important in this breeding work. They arise by hybridization on the barbery, but also by mutation in the greenhouse and under natural conditions in the field. It is now realized that biotypes within races are just as important as the races themselves and the susceptibility of Eureka has indicated how new biotypes of an old-established race can cause upset in any breeding programme. However, provided the parental variety maintains its resistance to old and new biotypes, then incorporating this resistance into agronomically desirable types is a relatively simple matter.

Western Australian Branch.

At a general meeting on 20th August, Dr. H. W. Bennetts, Veterinary Pathologist, Department of Agriculture, delivered an address on "Swine Fever".

The speaker gave a general account of swine fever, or hog cholera, which he said was generalized, usually acute infection with a virus. The disease is characterized by fever, depression, and high death rate; the typical changes in the carcase are widespread hæmorrhages notably in the lymph glands and kidneys. Pigs of all ages are affected, and no other species of animal is susceptible.

Diagnosis is not easy, and if any doubt exists transmission by inoculation with filtered blood is necessary for confirmation. The disease, both naturally and experimentally acquired, is very highly contagious. The virus is eliminated in large amounts in the excretions, and discharges, notably in the urine within a day or two of an animal picking up infection. Symptoms are not apparent for five or six days later; the carcasses of animals killed during this incubation period appear perfectly healthy and may be passed as fit for human consumption, although virulent virus is widely disseminated throughout the tissues. As the virus is very resistant to cold, although rapidly destroyed by putrefaction at higher temperatures, the meat of infected carcasses may contain potent virus for many months if stored at low temperatures.

Quarantine measures have generally kept Australia free from infection, and on occasions where swine fever has been introduced a rigid policy of slaughter of infected, and in contact pigs has resulted always in eradication, a state of affairs much preferable to control by immunization. The speaker gave an account of the 1927-28 occurrence in the eastern States, and of the 1942-43 outbreaks in W.A. and N.S.W. The latter outbreaks resulted from introduction of pork meats of U.S.A. origin due to wartime exigency. The outbreak in W.A. from September, 1942, to January, 1943, resulted in the death and destruction of 11,759 pigs, or 5 per cent. of the State's total population; approximately £28,000 was paid in compensation. The actual loss to the industry was estimated at £100,000, which, however, is small compared with losses which would have been experienced had the disease not been so speedily eradicated.

On 11th October, Mr. J. K. Taylor, Soils Division of the C.S.I.R., addressed Branch members and a number of visitors on "Surveys of Potential Land-Use".

The soil survey provides a fundamental basis for land-use, said the speaker. There is increasing recognition of its value among farmers, irrigationists, financial houses and administrators concerned with land settlement problems. If extension officers, agronomists, agrostologists and others concerned with agriculture will take the trouble to learn something of the soils in the districts where they are working their work may be greatly increased in value. Detailed soil surveys are often laborious and time-consuming, but a system which promises to be of value involves only broad traverses, say at half-mile intervals, to map the general pattern of the major soil groups. Such work is greatly facilitated by aerial photographs of the area. Detailed soil surveys on selected representative areas would then follow, and would serve as a basis for subsequent advisory work.

The soil surveyor, who should have a basic training in agriculture, maps the present land-use as well as the soils, also such man-made factors as waterlogging and salinity and soil erosion. After working through a district the soil surveyor will have considerable knowledge of what problems exist in the area and his opinions should receive due weight in planning for their solution. In assessing the potential land-use of any undeveloped or partly developed areas, there is far more to be done than mapping the soils. Points for consideration include: (a) Climate, especially the microclimate as influenced by topography and soil characteristics. (b) Assessing the possible relative productivity of various soils for various crops in the light of existing knowledge. (c) The best use to make of an area. This, like (b), calls for co-operation of specialists in many branches. (d) Agricultural problems existing or which might arise. Again this calls for co-operative efforts. (e) Economics and sociological factors and studies.

Current Notes and News

Land and Water Development in Queensland.

A Bill to plan, co-ordinate, and provide for the development and use of the land and water resources of Queensland was passed by the Queensland Parliament in November. The Bill provided for the setting-up, within the Department of Public Lands, of a Bureau of Investigation charged with the responsibility of surveying and investigating the land and water resources of the State and of continuously investigating land development. It was stated during debate that the Bureau would be constituted, if possible, of an expert hydrologist, a forestry officer, an agriculturist, a land-settlement expert, and a chairman with a wide knowledge of the resources of the State. Local advisory committees may be set up.

The Bill also provided that the Minister for Public Lands should have authority to require any landholder to submit plans for the development of any undeveloped land held by him, and where satisfactory development is not assured the Crown may resume the land.

In connection with development of the water resources of the State, Parliament granted the Lands Department authority to establish a water-supply, irrigation, water-conservation or water-distribution undertaking costing up to £125,000. Where such an undertaking has been provided, any landholder whose land can be served by such undertaking may be required to bring any suitable land on his holding into production by ringbarking, scrub-felling, clearing, stumping, grubbing, water-reticulation or water-conservation works, or cultivation for the conservation of fodder, and construction of silos. Any part of the State may be declared a development area, and, in such areas, no land shall be subdivided, leased or sold without approval.

Personal Notes

At the sixth general meeting of the Institute Professor G. A. Currie was unanimously re-elected President for the ensuing twelve months.

Wing Commander C. P. Glasscock, of the New South Wales Branch, has been posted missing from air operations over New Guinea. Sergeant S. M. Close, R.A.A.F., of the South Australian Branch, has been posted missing from air operations.

Lieutenant J. D. Bull (A.I.F.) is now known to be a prisoner of war in Malaya, and Corporal G. W. Clarke a prisoner of war in Thailand. Sergeant H. D. Richardson is a prisoner of war in Italy.

Flight Lieutenant M. V. O'Reilly (R.A.A.F.) has returned to Australia after considerable operational flying overseas. Sergeant W. T. Atkinson (R.A.A.F.) is now on operations overseas.

Captain S. L. Allman (A.I.F.), after extensive anti-malarial work in New Guinea, has been appointed officer-in-charge of an Anti-Malarial Control Unit.

Captain P. A. Reid has been mostly engaged in topographical work during his third year in the army. He was 2 I.C. of the Allied Geographical Section, a G.H.Q. unit of allied personnel, and was posted for operational experience previous to his recent return to Australia.

Mr. R. T. N. Pescott, former Entomologist of the Victorian State Department of Agriculture, has been appointed Officer-in-Charge of an Australian Mobile Entomological Section, with the rank of Captain. Captain Pescott will conduct entomological research work with particular reference to the control of insect-borne diseases.

Messrs. T. H. Kneen and P. F. Marriott, who were attached to the Horticultural Branch of the Victorian Agriculture Department before enlistment in the A.I.F., have received appointment to commissioned rank.

Mr. J. F. Kennedy has been released from the army for District War Agricultural Committee work in Queensland.

Mr. W. Poggendorf, who has been specializing in oil and fibre crops in the N.S.W. Department of Agriculture since the outbreak of war, has been appointed a member of the Plastics Subcommittee of the N.S.W. Reconstruction Advisory Committee.

Dr. J. W. Evans has been appointed to the position of Senior Entomologist on the staff of the Imperial Institute of Entomology, and expects to commence duties in London in April.

Mr. R. E. P. Dwyer, former Economic Botanist in the Mandated Territory of New Guinea and late of the New Guinea Rifles, has discontinued his work with rubber-producing plants in Queensland and will shortly take up duties on a Production Control Board in New Guinea.

Arrangements have now been completed, subject to approval by the manpower authorities, for Mr. J. R. Goode, late of the A.I.F., to enter the service of the Broken Hill Proprietary Limited as an agronomist. Mr. Goode will be working on the development of a comprehensive irrigation project from which it is hoped to provide Whyalla with vegetables, fruit and milk, and also parks and gardens. The project has been made possible by the recently completed Morgan-Whyalla pipeline which, it is estimated, will provide 1,200 million gallons of water a year. Mr. Goode's functions will also include the maintenance of the natural vegetation in and around the town.

The University of Adelaide has granted Mr. A. E. Scott twelve months' leave of absence from his duties at the Waite Institute to fill, temporarily, the position of Assistant Secretary (Technical) with the C.S.I.R., Division of Industrial Chemistry, Melbourne.

Dr. A. R. Callaghan will resume his full-time duties at Roseworthy Agricultural College in December, after a long period of having been seconded to the Commonwealth Department of War Organization of Industry. Dr. Callaghan's service will continue to be available to the Department in an advisory capacity.

Mr. K. Woodroffe resumed work in the Agronomy Department of the Waite Institute towards the end of November. Mr. Woodroffe had been engaged in the Department of War Organization of Industry.

